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INTERNATIONAL CLINICS

A QUARTERLY

OF

ILLUSTRATED CLINICAL LECTURES AND
ESPECIALLY PREPARED ORIGINAL ARTICLES
ON

TREATMENT, MEDICINE, SURGERY, NEUROLOGY, PÆDIATRICS,
OBSTETRICS, GYNÆCOLOGY, ORTHOPÆDICS,
PATHOLOGY, DERMATOLOGY, OPHTHALMOLOGY,
OTOLOGY, RHINOLOGY, LARYNGOLOGY,
HYGIENE, AND OTHER TOPICS OF INTEREST
TO STUDENTS AND PRACTITIONERS

BY LEADING MEMBERS OF THE MEDICAL PROFESSION
THROUGHOUT THE WORLD

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Diagnosis and Treatment

HEALTH BEFORE BIRTH: ANTE-NATAL HYGIENE AND EUGENICS

BY J. W. BALLANTYNE, M.D., F.R.C.P.E.

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A good many attempts are being made at the present time to influence beneficially the life before birth, with the result that there is some confusion in the mind of the medical profession, not to speak of the general public, as to the exact means which are being advised or taken to achieve so desirable a consummation. There is, for instance, the subject of antenatal hygiene, upon which I have written several books and a number of articles at various times in the past twenty-five years; and there is the cult or study of eugenics which is standing so fully in the blaze of publicity at the present time. In what relationship do these two subjects stand to each other? Does eugenics embrace antenatal hygiene, or is antenatal hygiene the subject with the wider range within which eugenics is included? Has the pre-maternity ward in the Edinburgh Maternity Hospital anything to do with eugenics, and are the babies born to the mothers in that ward "eugenic infants"? Am I myself a eugenist, or am I opposed to eugenics? The answers to these questions, so far as they are personal, may be of very little interest; but it will be of real importance to both subjects to attempt to define their relations, and it may prove to be a matter of general concern to many people. The whole atmosphere surrounding the question of procreation at the present time requires clarification. Mankind having apparently made up its mind to experiment upon its own reproduction, it is well that some precision should be introduced into the terminology of the subject; it is necessary, too, that the issues involved should be, at any rate, stated.

Whether antenatal hygiene includes, or is included in, eugenics is,
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of course, chiefly a question of definitions. What, then, is the definition of antenatal hygiene? Personally I have always regarded antenatal hygiene as the health aspect or side of the subject of which antenatal pathology was the disease aspect or morbid side, looking upon the one as the complement of the other, and on the two together as constituting the whole of our knowledge of health and disease before birth. This raises the further question: What exactly is included in antenatal pathology?

When, in 1892, I published the first instalment of what was intended to be a series of volumes dealing with the morbid states found at birth, and therefore, of course, developed before birth, I gave it the title of the "Diseases and Deformities of the Fœtus," and added the sub-title of "An Attempt Towards a System of Antenatal Pathology." This was, so far as I know, the first occasion on which I employed the term *antenatal pathology*; I might have called my subject prenatal pathology or antenatal medicine, but for some passing or accidental reason, which I have now forgotten, I chose the words "antenatal pathology." The word "antenatal" had the sanction of Sir James Murray's New English Dictionary. It had been used in 1817 by Shelley, who spoke of "memories of an antenatal life"; by Kingsley in 1848 when he referred to "heaven my spirit's antenatal home," and by Farrar in 1879 when he described the "antenatal predilection for Israel and detestation of Esau"; it could not, therefore be wrong for me to follow the example of these men. As to the word itself, it simply meant "happening or existing before birth." I need not stay to define *pathology*: I took it to be the department of medical study which treats of the causes and nature of diseases or abnormal bodily affections or conditions.

At first I thought that in three volumes of 250 pages each I should be able to deal exhaustively with all the diseases of the fœtus, and that another three or four volumes would contain the malformations and monstrosities of the same. But I made a huge miscalculation, as became evident as soon as the second volume appeared in 1895. In these two instalments *I was able to describe only some of the diseases of the subcutaneous tissue and skin of the fœtus*; some ten further instalments would have been necessary to complete the work on the scale and with the detail intended, and then I should have been left with all the monstrosities and deformities untouched!

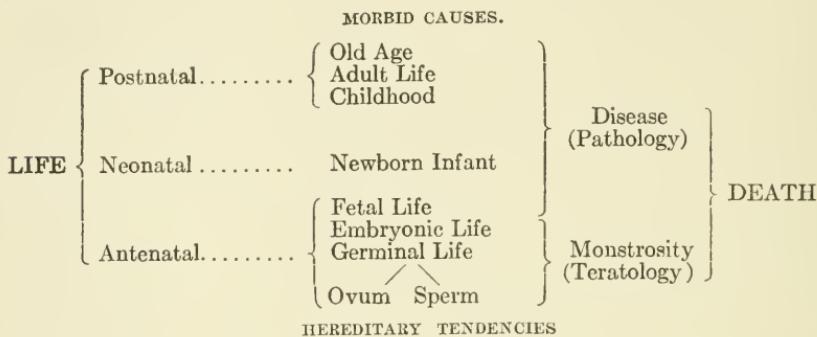
As has happened to me on other occasions, the plan of my project was far too large and was quite beyond my resources.

Meantime, in 1894, I had begun to bring out *Teratologia, a Quarterly Journal of Antenatal Pathology*, and this continued to appear for two years, when the smallness of the subscription list brought it to an end; "a premature birth, not an abortion," was what I called the result in the valedictory letter to my "few but fine" subscribers. In the preface to the first volume (1894) I described it as "a new departure," and said that the reader would for the first time in the history of medicine be provided with a journal dealing exclusively with antenatal disease and deformity and with certain closely-associated neonatal states. During its publication I was beginning to give more thought to heredity in connection with antenatal morbid conditions, and the appearance in its pages of Dr. Féré's paper on the effects of microbic toxins and the alcohols upon the life before birth brought to me a new conception of the scope of antenatal pathology; his paper, at any rate, was one among several things which had this result.

In my address to the Glasgow Obstetrical and Gynaecological Society in February, 1898,¹ I tried clearly to define my views as to the scope and contents of antenatal pathology. I then subdivided prenatal life into three periods, and found that three sets of pathological states were associated with the three periods. The periods were: First, the fetal, corresponding to the last seven months of the mother's pregnancy, and having for its typical morbid states the diseases of later life modified by the intra-uterine environment; second, the embryonic, extending roughly from the second to the eighth week of pregnancy, and having as its peculiar morbid attribute the production of monstrosities and deformities; and, third, the germinal period, occupying the week following impregnation and extending also right away back into the lives of the parents and ancestors in the somewhat problematical vitality of the germ-cells lying in the parental genital glands, and having, as its special pathological manifestation, morbid heredity and some other curious developments, such as double monsters and teratomata. I insert here the schematic representation of life which I gave at the Glasgow lecture.

¹ *Glasgow Medical Journal*, xlix, 241, 1898; *Archives of Pediatrics*, xv, 434, 1898.

It shows the various periods of life acted upon by "morbid causes" on the one hand and controlled by "hereditary tendencies" on the other.



The three divisions here indicated and the special pathology peculiar to each were much more fully described in the lectures on antenatal pathology and teratology which I gave in the University of Edinburgh (1899-1900) and at the Polyclinic in London in 1900. In these lectures, too, I began to deal with antenatal hygiene; indeed, there was one devoted entirely to antenatal therapeutics, and it was published later in the *British Medical Journal* (vol. i. for 1899, p. 889). This was, of course, the practical side of the subject, but I had been prevented from embarking upon it by the apparent hopelessness of antenatal diagnosis and by the mystery of antenatal causation. As, however, I began to realize that the same morbid causes were in action in antenatal life as in postnatal, that they were likewise active in each of the three periods of antenatal existence, and that the extraordinary differences in the results of their action (diseases, deformities, monstrosities, morbid tendencies) were due rather to the conditions peculiar to the life of the period than to any difference in the causes themselves, I began to see some hope of taking preventive measures and of doing good thus, even if I were still quite unable to diagnose the state of the infant *in utero*.

When, therefore, in 1902, I published the first volume of my work "A Manual of Antenatal Pathology," I ventured to add "and Hygiene" to the title; in that volume and in the one which followed it in 1904 I devoted some chapters to antenatal hygiene and to the treatment of the infant before birth; and I divided the subject into three divisions, corresponding to the three departments of antenatal

pathology, viz., fetal, embryonic, and germinal hygiene. By antenatal hygiene, therefore, I meant the preservation or restoration of the health of the new being before birth in the fetal, the embryonic, and the germinal stages of his existence. Naturally the preservation and restoration of antenatal health can be effected only through the mother for the fetal and embryonic stages, and, through her, the father, and earlier ancestors, for the germinal period; for, it will be remembered, I did not limit germinal life, in my definition thereof, to the vitality in the ovum following impregnation, but carried it back into the germ-cellular life of the ovum and spermatozoon before impregnation. Taking, therefore, my wide definition of antenatal hygiene, it is obvious that, since it includes the attempt to restore or preserve the health of the germ-cells in the bodies of the parents, grandparents, and earlier ancestors, it includes eugenics.

Before, however, trying to estimate the value of the last-named sort of antenatal hygiene, let me state how it came about that I wrote so much more of the other kinds of prenatal treatment. While I was engaged with my "Manual of Antenatal Pathology and Hygiene" I was brought into touch with the problems of the pathology of pregnancy in a very practical way at the Edinburgh Royal Maternity Hospital, and was led to publish the plea for a pre-maternity hospital² which brought about the establishment there, first of a pre-maternity bed and then of a pre-maternity ward. I had, therefore, opportunities of treating pregnant patients who were ill and, through them, of treating likewise their unborn infants; as time went on I also got chances of treating expectant mothers whose previous pregnancies had resulted in the birth of dead, diseased, or deformed infants and who yet in themselves did not and had not suffered from any appreciable or obvious disease. The results I obtained in these cases led me to think more and more of antenatal hygiene after impregnation and less of that which goes before it. With the mating of the parents my hospital work gave me nothing to do; my patients were the mother and the child (fœtus, embryo) in her womb, and my business was to make the woman herself healthy and so to act beneficially on the unborn infant through his maternal environment. I was treating him before his birth, but I was not, of course, in the position of being able to determine his heredity.

² *Brit. Med. Journal*, i for 1901, p. 813.

That, according to received opinion, was settled before or at his conception. I am emphasizing these distinctions, for there is still a tendency even in the minds of scientific men to regard the characters which exist before birth as necessarily hereditary; some of them, of course, are hereditary, but others are clearly the result of the action of toxins, microbes, and poisons in the maternal tissues which pass over and affect the organs of the unborn child, be he *fœtus* or embryo.

When, therefore, I had finished the first volume of the "Manual of Antenatal Pathology," which dealt with the *fœtus* and its diseases, and was nearing the end of the second volume, which had for its subject the embryo and its malformations, I had to consider how I was to treat the germ and morbid heredity. There ought to have been a third volume in which would have been discussed heredity in its physiological and pathological aspects, as well as the hygiene of heredity or the improvement of bad heredity and the preservation of good heredity by such measures as have recently been advocated (*e.g.*, elimination of the unfit in marriage, encouragement of the mating of the best, etc.); but, for several reasons, I came to the conclusion that the third volume should then, at least, remain unwritten, and I simply put a few chapters at the end of the second volume to indicate the outlines of the way in which I should have treated the pathology and hygiene of the germ. One of the reasons was lack of time for the intense study which I saw would be needed to put myself abreast of modern views on the theories of heredity; another was the consciousness of the extreme tenuity of the chain of ideas in my mind which stretched between what I knew with certainty and what I was forced to accept on hearsay or on the authority of others; and yet another was the interest which I was compelled to take in the mothers and their unborn infants who were coming to me for advice and treatment, both in private practice and in the pre-maternity department of the hospital. I knew there were hereditary problems of the greatest magnitude to be faced—indeed, I had now and again to give advice in connection with some of them; but in the main my patients were the expectant mothers and their expected but as yet unborn infants *in utero*, not so often the future parents of the race and the germ-cells in their reproductive glands.

Antenatal hygiene, therefore, while definable in a wide sense as the preservation or restoration of health before birth and either after

or before impregnation, came to signify for me the care of the unborn infant in the womb during the nine months after impregnation and by means of treatment (dietetic, medicinal, regiminal) of the mother. I found myself looking at race-betterment from the standpoint of the infant *in esse*, so to say, in the uterus, and not from that of the infant *in posse*, in the reproductive glands of persons not yet mated or, at any rate, not yet parents. Now the part of the field of antenatal hygiene on which I was not concentrating my attention was just the part the eugenists were beginning to study with enthusiasm and zeal, aided and stimulated as they were by the rediscovery of the principles of Mendel and other advances in the theories of heredity. They laid the emphasis on mating and on improvement of the stock from which the race springs before impregnation, or, in other words, ante- or pre-conceptional hygiene; while I was more concerned with post-conceptional health, with the well-being of the embryo and unborn child as he lives and develops and grows in the womb. I, of course, admit—would never think of doubting—the existence of a hereditary factor in antenatal affairs in all the stages into which the life before birth is divided, but it does not seem to me to be the most important factor; the eugenists, I presume, do not refuse to recognize the presence of an environmental factor before as well as after birth, and even in the long ante-conceptional time when the germ- and sperm-cells are lying in the tissues of the parents, only they do not lay the same stress upon the environmental influences as they do upon the hereditary.

It may, of course, be claimed by those who think heredity is the more important factor that the term "Eugenics" includes also the nurtural (as they have been called) as well as the natural influences which work upon the unborn infant in all the stages of his prenatal existence; but the ordinary definitions of "eugenic" do not quite bear this out. The common definition of *eugenic* to be found in the dictionary is "pertaining or adapted to the production of fine offspring, especially in the human race," and it seems to have been first employed by Galton in 1883; while *eugenics*, the plural substantive constructed in analogy with obstetrics and economics, is the science which has the above-named purpose as its object. Sir Francis Galton's word "eugenism," introduced about 1887, is used to express the aggregate of the most favorable conditions for healthy and happy

existence. The Eugenics Education Society at the present time places the following definition of the subject with which it deals on the front page of its documents: "Eugenics is the study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally." This definition widens the sphere of the operation of the work of the society, bringing in, as it does, the pathological element ("or impair"); on the other hand, it narrows it by using the words "racial qualities." Of course, "racial qualities" may be understood in different senses, too. But let us see what Major Leonard Darwin, who may be regarded as the spokesman of the Eugenics Society, has to say on the definition and scope of his subject. In his presidential address, given on June 12, 1913, he referred to the making of improvements in the mental and physical surroundings of human beings, as well as to the endeavor to improve the inborn qualities of the generations of the future by methods which regard this generation as the ancestors from whom those inborn qualities will have been derived. He said:

Since the avowed object of the eugenist is to improve the *racial* qualities of future generations, both these methods of benefiting posterity seem to fall within his province; provided, that is, that a somewhat wide and indefinite meaning be attached to the word "racial"; and from certain points of view it is, no doubt, convenient to group the environmental and hereditary methods of benefiting mankind under the one general heading of "Eugenics." Some eugenists, in their most legitimate desire to draw attention to questions of heredity, have, it is true, been led at times to attach too little weight to the fact, as Professor Pigou has recently expressed it, that environment as well as people have children, and have paid but scant attention to the ultimate effects of reforms affecting human surroundings. It must, indeed, be owned, even if we admit the great value of environmental reforms, that they constitute a ground which has long been occupied by the social reformer and for which no new name was needed. On the other hand, in favor of giving a wider meaning to the term "Eugenics," it has been urged with considerable force that, by including the direct effects of change of environment within its scope, our society would be brought in harmonious coöperation with useful allies; and it was, I believe, only when the advisability of attempting to combine in one army all the forces fighting for human improvement was pressed on Sir Francis Galton that he agreed to accept a definition of eugenics which might have the effect of including within its scope studies having no connection whatever with heredity.

Notwithstanding what he had said and the conclusion to which Sir Francis Galton had come, Major Darwin was of the opinion that "whilst fully agreeing that any rigid definition tending to limit the sphere of the activity of our society might produce harmful

results, we may nevertheless feel that it would be convenient if we could restrict the use of the word 'Eugenics' to the study of agencies affecting the *inborn* characters of future generations, whilst using the term 'social reforms' for those benefits which may be passed on to posterity in ways other than those attributable to true biological heredity." Major Darwin himself is using "Eugenics" in the above limited sense, and defines shortly the aim of the eugenist as "to benefit posterity through the agency of heredity": while the aim of the social reformer is to secure immediate advantages for his fellow-citizens—advantages which may or may not beneficially affect posterity.

Here, then, we have the wide and the narrow limits of both subjects defined. Antenatal hygiene, in its wide sense, is the preservation or restoration of the health of the new being before birth, in the foetal, the embryonic, and the germinal stages of his existence,—*i.e.*, both after and before impregnation. In the narrower sense in which I have sometimes employed it, it is the preservation or restoration of the health of the infant before birth during the nine months which follow upon impregnation. Eugenics, in the wide sense of the word, is the means taken to benefit posterity through agencies under social control which may improve or impair its racial qualities, either physically or mentally. In the less wide sense of the word, the aim of the eugenist, as defined by Major Leonard Darwin, is to benefit posterity through the agency of heredity.

The two subjects, therefore, in their widest scope are not very different, and they are to be distinguished chiefly by the incidence of the emphasis: the man who is working for antenatal hygiene lays the stress upon making the prenatal environment satisfactory by keeping the mother healthy, and if she and her husband come of a stock with a good heredity, so much the better for the child of their union; the eugenist, on the other hand, puts the emphasis on heredity, and is not so much impressed with the value or influence of the surroundings of the child before birth as with the potency of the innate (*inborn*) characters which the unborn child's tissues already possess to render all environment, whether antenatal or postnatal, inactive or ineffectual.

Some of the confusion has also arisen from the ordinary meaning given to such words as "innate," "native," "natural," and "in-

born": keeping in mind the Latin word *natus* and the English word *born*, one is tempted carelessly to think of all characters or conditions found *at birth* as innate or inborn. Of course, they are not so: a mother may become infected with syphilis or smallpox during her pregnancy and infect the child in her womb with the same disease; his syphilis or his smallpox is in him when he is born, he is born with it; but he has not received it by heredity, it is not an innate condition or character, although it is just possible that we may say with some degree of probability that his heredity makes him more or less liable to either infection. These morbid states are congenital or connate; they are not what the eugenist means, I presume, when he uses the word "innate" or "inborn." What he wishes to express, I take it, is that innate characters are the ones found in the ovum immediately after impregnation, and in the ovum and spermatozoon before that great stage in life has been reached. I am scarcely prepared to admit that all the characters found even at this much earlier time in life are innate or inborn in the hereditary sense of these words; for it seems to me quite possible that germ-cells lying in the reproductive glands may undergo changes due to their environment and even be influenced by poisons or microbic toxins circulating in the blood passing through these glands; but I am content in the meantime to carry the problem back to, but not beyond, impregnation.

It will, of course, be said that no one could ever regard syphilis or smallpox as innate things in the sense of heredity; and that conclusion is fair enough. It is, however, quite different when one takes for discussion such a condition as tubercle. It is, every one knows, very rare for the foetus of a tuberculous mother to be infected *in utero*, but undoubted cases have occurred in which the infant at birth had tubercle bacilli in his tissues and could be regarded with full bacteriological and pathological sanction as tuberculous. His tuberculosis, nevertheless, was not in his case a hereditary malady, but an antenatal infection due to the blood of his mother containing bacilli. Yet in other cases tuberculosis is spoken of still as hereditary, and there are some who will not think it strange to postulate a tendency to become tuberculous as one of the characters present in the ovum at or before impregnation. Here, then, the difficulty of distinguishing between hereditary maladies and antenatal infections becomes a real one: both the actual tuberculosis which has been gotten from the

mother and, let us say, the hereditary tendency to develop tuberculosis which has been handed down from one or both parents may be present in a child at birth, but both are not innate or inborn; one at least is congenital, being an infection which has occurred in the antenatal life of the child after impregnation.

It will, therefore, be necessary for the eugenists to carry their definition of "innate" or "inborn" further back than birth, if anything like a clear distinction is to be made between the characters which are acquired during the nine months spent in the womb and those which are present at impregnation. Before birth, environment, which is then maternal pure and simple, is producing its effect upon the baby about to be born, and its results must be considered apart from those conditions which have been handed down from ancestors in past generations. It will be said that this is very difficult, if not sometimes quite impossible; it will be urged that while after birth it is easy to distinguish between nature and nurture, it is extremely hard to separate these two forces in antenatal life. That is precisely the conclusion to which I have come. The crux of the whole matter lies in the antenatal part of it. The presence of environmental agencies before birth complicates and confuses the issue: antenatal hygiene must take into account hereditary influences, and eugenics cannot afford to neglect environmental forces.

It would seem, therefore, that antenatal hygiene and eugenics ought to work together, for they are linked together by the common desire to improve the physical and mental state of the infant at birth and by the impossibility of disregarding either the hereditary or the environmental factor in their efforts. At the same time it may be wise at present for the eugenists, who have so clearly announced their allegiance to the hereditary agencies, to carry on their campaign with, so to say, their own weapons and commissariat, while those who rely on endeavors to check prenatal disease, death, deformity, and debility by attention to antenatal hygiene will make their chief attack on these morbid states by means of gestational therapeutics and the care of the pregnant woman. In the camp of the eugenists will be found the biologists, and in that of those who practise antenatal hygiene will be medical men (especially obstetricians) and social reformers, particularly such as belong to the National Association for the Prevention of Infant Mortality and for the Welfare

of Infancy and to the Women's Municipal League of Boston (with its Committee on Infant Social Service and Prenatal Work). It may be mentioned here as a matter of some interest that at the recent conference of the former association held in London last August the whole of one session was given up to antenatal hygiene. By this separate action it may be possible to form some opinion as to the relative value of the two plans of attacking antenatal and hereditary evils and of securing prenatal health and a good stock.

I have thus attempted to answer some of the questions referred to in the first paragraph of this article; but it may be well if I try to give a more direct answer to some of them. If we adopt a wide definition for eugenics, then that study includes antenatal hygiene; on the other hand, if we include in antenatal hygiene the attempt to obtain hereditary as well as environmental health before birth, then we have embraced a large part of eugenics. If, however, we take the narrower definitions of these two departments of beneficent prevention, they stand separate and apart and, with a common purpose, pursue different tracks to reach it. I am certainly not "anti-eugenic"; I can never imagine myself as opposed to the procreation of the best babies, although I may have doubts and scruples as to some of the methods proposed to obtain it and denominated "eugenic"; but the wider the scope given to the definition of eugenics, the heartier will be my sympathy. Meanwhile I think there is some danger of excessive zeal and too optimistic endeavor. With regard to the infants born to mothers who have had treatment in the pre-maternity ward of the hospital with which I have to do, I think it may safely be said that they are not "eugenic babies" in the sense in which eugenists would employ the words. Truly no particular care, no care at all, has been given to the mating of their parents, who are simply folk of the lower or middle working class. Further, the mothers come into the ward for some illness connected with their pregnancy or because their children in previous pregnancies have died or been abnormal in one way or another. They could not, therefore, be called either well-begotten or well-borne babies. Let me say at once that they were not all born out of wedlock: during the autumn quarters of 1909-1912 (inclusive) there were 125 pregnant women treated in the ward, and of these 94 were married and 31 unmarried, and the figures for 1913 were similar; for it must be

remembered that entrance to the pre-maternity ward is not given because the woman is married or unmarried, but because she is suffering from a malady of gestation. In many cases the babies of these women were neither well-begotten nor well-conceived nor yet well-borne; but it was our endeavor to improve the latter state, as well as to get them safely born, and I think we can claim that in many instances we had success, and could say that but for the days or weeks spent by their mothers in the pre-maternity ward the offspring would have been less strong, less healthy, and of less weight and development. The pre-maternity ward is not a place in which an experiment in eugenics is being tried; it is a place in which an attempt toward antenatal hygiene is being made.

The most difficult question remains to be answered. Which is likely to be the more successful, antenatal hygiene or eugenics? Which plan will it be more profitable to prosecute? I incline, as may be expected, to the former; but I freely admit that there are few statistics of results to be scrutinized or argued from. I can confidently say that lives, infantile as well as maternal, have been saved in the pre-maternity ward, and that women who had disastrous pregnancies previously, gave birth to healthy infants after residence and treatment in the ward; but I am still working with a comparatively small number of cases, and what is needed is that antenatal hygiene by the medical supervision of pregnancy should be attempted and tested on a large scale. In Boston, too, good results are reported from the prenatal work carried on there outside the maternity hospitals; and Dr. Bordé has given a very encouraging account of the effects of residence in the *Asilo di maternità di Bologna* (a sort of pre-maternity home for unmarried expectant mothers), while endo-uterine puericulture (as prenatal treatment is called in France) has had its successes in Paris. These are only beginnings—small beginnings, perhaps—but they show, at any rate, that it is worth while to make experiment along such lines. It may be said that there is no proof that any truly hereditary morbid state in the unborn infant can be altered before birth by the very best care given to the pregnant woman who carries him, and, although I am not prepared to admit this conclusion in respect of haemophilia, it may be at least granted that it is difficult to imagine any mechanism by which hereditary maladies can be brought under the influence of environmental states.

Still, the embryo and foetus before birth are undoubtedly more plastic than the child after it is born, and it is conceivable that the ordinary rules of heredity, so far as they have been surely ascertained, may be modified by antenatal circumstances, just as their results can be ameliorated after birth. This theme might be developed further, but at present I am rather dealing with broad issues than with details.

Eugenics, like antenatal hygiene, has not many results to lead forward. In the nature of things, eugenic results demand long periods of time, and probably not even the most enthusiastic or the youngest eugenist hopes to see the Utopia of his imagination fulfilled in this or the next generation. Gentle measures, will take time, much time, to give effects; strong measures, such as sterilization of the unfit, are little likely to be easily accepted by a populace which "conscientiously objects" to having its babies vaccinated against smallpox. Indeed, I may for myself enter a protest against the strong methods of the advanced eugenist; they seem to me to smack of reversion to type, a return to the plan of destroying or preventing life rather than of saving or furthering it. I admit that one is here entering into a sphere of metaphysics and high ethics in which one must walk warily; but that the eugenist, like every other reformer, must sooner or later enter into this sphere can hardly be denied. At any rate, it is safe to say that no body of scientists could in the present state of our knowledge of all the problems of heredity lightly declare who were the hopelessly and irremediably unfit, even if it were at all likely that any body of scientists could hope to receive permission so to classify or designate their fellow-men.

In conclusion, while I am not opposed to eugenics of the milder kind, in moderation, and tentatively employed by educational means chiefly, I think that experiments in the direction of sterilization, in the absence of the surest knowledge of what constitutes and can be accepted as an unfitness which is not to be propagated and for which there is literally no hope, are highly dangerous and capable of being more disastrous than the very evils they are intended to remedy. Even Plato, who is often referred to as an early eugenist in connection with certain passages in the *Republic*, the *Timaeus*, and the *Laws*, was not so certain about the results of selected mating, but made provision for the unexpected in both directions, conceiving that the

children of the best might turn out badly and the children of the less worthy might turn out well (*Timaeus*, 18, 19). Indeed, if we are to invoke what Socrates said, as represented by Plato, we must also quote the passage in the *Laws* (vii, 792) which is in favor of antenatal hygiene by care of the expectant mother, and which reads (I quote from Jowett's *Translation*) : "I would say that a woman, during her year of pregnancy, should of all women be most carefully tended, and kept from violent or excessive pleasures and pains, and should at that time cultivate gentleness and benevolence and kindness." I am personally of the opinion that more immediate and practical good is to be gotten from the practice of medical and hygienic supervision of the mothers in their period of expectancy than from eugenics; at any rate, the attempt to attain to antenatal health by means of gestational hygiene and therapeutics can be much more quickly put to the test than the endeavor to improve the race by selected mating. I think it ought to be put to the test, involving, as it does, no apparent risks and the very slightest interference with use and wont. In a few words, mankind at present is experimenting, or is likely to experiment, with reproduction in three directions: it is reducing the birth-rate by measures among which the checking or preventing of impregnation must be regarded as one; it is asked to see to it that pregnant women are more tenderly cared consequently likely to bring about a further reduction in the number of babies, even if it succeeds in improving the quality of them; and it is asked to see to it that pregnant women are more tenderly cared for, more scrupulously protected from illness and morbid agencies of all kinds, and more effectively brought under medical supervision, not only for their own sakes but for the well-being and health of their infants about to be born. I express no opinion about the first experiment; I regard the second as well meaning and well worth inquiring into and even testing carefully and circumspectly; the third, I strongly urge, is worthy of an extensive trial.

TREATMENT OF PROSTATISM

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PROSTATISM is a term of clinical significance, and is applied to a group of pathological processes that are met with frequently in the prostate gland. These diseases produce local deformity of the organ, interference with the complete emptying of the bladder, damage to the genito-urinary tract above, and serious ill-health to the patient.

The frequency with which chronic prostatic disease is met with in elderly men is known well by the medical profession and familiar to a large number of the general public. As it is met with so frequently, it has come to be looked upon as a natural incidence of advancing senility and one of the penalties of old age. Thompson and Richardson state that chronic prostatic enlargement has been found in 34 per cent. of men over the age of 60, of which number 15 per cent. suffered from symptoms. Plondke has estimated that 33 per cent. of all men over 50 years of age suffered from enlarged prostate, and that 10 per cent. of these require treatment.

Although the frequency with which chronic prostatic disease is met with is generally recognized, at the same time it is noteworthy that the effect of its presence is apparently often belittled, so that, in the majority, it is only in the later stages of the illness, at a period when it gives rise to serious discomfort, that the advice of the surgeon is sought for, and he is called upon to endeavor to give relief. It is, however, important to remember that discomfort is usually a terminal manifestation of the disease: the patient's health has, previous to this, been steadily undermined, his life has been much shortened, and his prospects of obtaining a permanent cure by surgical means very much diminished. In consequence, the mortality that attends treatment is extremely high, and the benefit that is conferred upon many is somewhat doubtful.

When such is the case, it is important to consider whether surgical treatment of those diseases that give rise to prostatism should not be undertaken at an earlier stage than is customary at present, instead of waiting until permanent and irreparable damage

has developed. The soundness of this proposition is recognized in every other department of surgery. Curative surgery is only possible when undertaken at the inception of the disease, before the patient's health is seriously undermined.

Before treatment can be undertaken it is necessary to consider the various pathological processes met with in the prostate gland, that are found in this disease, and the harmful effects, if any, that result from their presence. When these are realized, we will then be in a position to understand the manner in which treatment can be carried out, so as to cause the minimum amount of damage to the tissues at the time, and consequently the least risk to life, and the maximum prospect of a permanent restoration to good health thereafter.

With the object of determining the morbid anatomy of the diseases producing prostatism, I have recently examined specimens from 134 such cases. These comprised cases operated on where the gland was removed by suprapubic or perineal prostatectomy. In certain of them the operation was followed by a fatal result, and in them the pathological changes in the genito-urinary tract were studied at postmortem examination. There were also investigated certain cases dying naturally of prostatism without treatment. The method employed was to fix the tissue *in situ* and to make complete serial celloidin sections with a large Bruce's microtome. By this means the state of the gland and the effect it had produced on the neighboring tissue were revealed in a lucid manner. On the pathological changes observed in combination with the clinical features of the cases the following descriptions are based.

It is recognized that prostatism may arise from a variety of pathological lesions. The majority produce hypertrophy of the gland; all are of the nature of a chronic prostatic disease, and at one period are amenable to direct operative treatment. In 134 cases examined by me, three outstanding varieties of disease were present: (1) Prostatic hypertrophy, or chronic lobular prostatitis, 110 cases; (2) prostatic fibrosis, or chronic interstitial prostatitis, 10 cases; (3) prostatic carcinoma, 14 cases.

PROSTATIC HYPERSTROPHY, OR CHRONIC LOBULAR PROSTATITIS

The disease is virtually always associated with a great increase in the size of the gland, but it is occasionally met with in glands

that are even smaller than normal, but clinically have produced pronounced indications of prostatic dysuria. Tandler and Zuckerkandl, as a result of their investigations made on subjects dying naturally with prostatic hypertrophy, have shown that prostatic hypertrophy is always found involving the middle lobe. In those cases that I have examined it is undoubtedly by far most commonly met with in that situation, but it is also clear that the lateral lobes are frequently also involved. In one specimen the disease was confined to the anterior lobe. This latter condition is, however, unique.

When the prostate gland, the site of chronic lobular prostatitis, is sectioned and examined, it is usual to observe areas of glandular overgrowth scattered irregularly throughout its substance. These most usually form spheroids of varying size, and are surrounded by a ring of prostatic tissue that has been uninvolved in the disease, and become compressed to form a coarse trabecula throughout the gland. This displacement and condensation results in the formation around the periphery of the diseased organ of a thick layer of fibrous tissue, non-striped muscle, and compressed and degenerative glandular acini, which is known as the false capsule. It will be found that between the false capsule and the area of disease the flattened-out glandular acini form a line of natural cleavage that permits of the easy separation of the diseased tissue beneath from the false capsule surrounding it. In a typical case these flattened acini form an arrangement somewhat like the perforation around a postage stamp, the perforation being, however, longer and the bridges much farther apart. Very occasionally a spheroidal area of hypertrophy is seen, where the stroma is increased very much in amount and the gland tissue very much reduced in quantity, so that a fibromyomatous nodule is produced. These are, however, not true neoplasms, and of all the cases where I have observed it in only one did I fail to detect the presence of atrophied gland tissue amidst the fibrous and muscular tissue, and in this case circumstances did not permit of a complete section of the entire gland. These fibroid areas are probably the result of a former inflammatory process.

When the prostate gland enlarges in chronic lobular prostatitis, in addition to producing for itself a false capsule, it usually herniates itself through the internal vesical sphincter, and comes to lie directly beneath the thin mucous membrane of the bladder floor. The disease

FIG. 1.

Urinary tract from a fatal case of untreated prostatism due to prostatic hypertrophy (chronic lobular prostatitis), showing enlargement of middle lobe of prostate forming pedunculated intravesical projection behind the urethra.

Note the indications of extreme backward pressure, hypertrophy of the muscular coats of the bladder, extreme dilatation of the ureters and renal pelvis, cystitis, acute and consecutive suppurative pyelonephritis ("surgical kidney").

History of the Case.—J. L., aged 65. Admitted to hospital 18 days prior to fatal termination of illness, suffering from severe prostatism. He came to hospital as he suffered from constant dribbling of urine; 48 ounces were drawn off. The urine contained pus and albumin. He was catheterized regularly and passed over 100 ounces *per diem*. Latterly this quantity became steadily diminished. He became drowsy and comatose, with a feeble pulse and indications of heart-failure. Temperature for a week from the day following admission ranged between 100° and 102°. Postmortem examination showed the changes indicated in photograph, with a dilated and hypertrophied heart, emphysema of lungs, and toxic changes in other organs of the body.

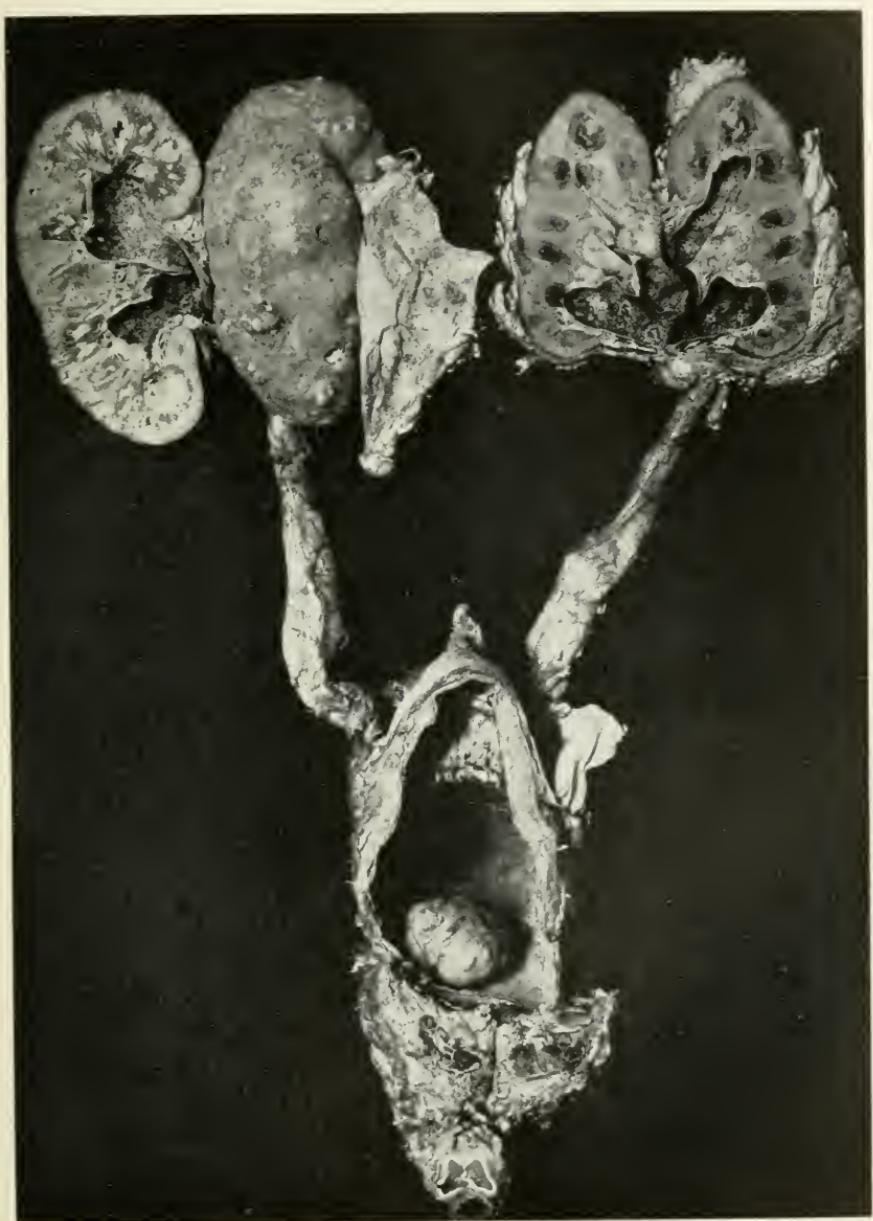


Fig. 2.



Kidneys and ureters from fatal case of untreated prostatism due to prostatic hypertrophy (chronic lobular prostatitis), illustrated in Fig. 1, showing the effect of prolonged backward pressure—dilatation of ureters and renal pelvis, pressure atrophy of renal parenchyma, chronic interstitial nephritis, with pyelitis of left kidney. Pyelitis and acute consecutive suppurative nephritis of right kidney. Note numerous abscesses scattered throughout the right kidney substance.

being confined to the middle and lateral lobes, the seminal vesicles and ejaculatory ducts are displaced into a region of safety.

The class of case above described, of advanced chronic lobular prostatitis, is the ideal one for suprapubic prostatectomy. Glandular hypertrophy has resulted in changes that render the operation possible and usually easy. It is important, however, to remember that cases of this disease are met with that are not ideal for this operation. These are: (1) Cases of chronic lobular prostatitis without hypertrophy; (2) cases of hypertrophy without intravesical herniation; and (3) cases of incomplete false capsule formation.

PROSTATIC FIBROSIS, OR CHRONIC INTERSTITIAL PROSTATITIS

Of the 134 cases I have examined, 10 suffered from prostatic fibrosis, or chronic interstitial prostatitis. In this disease the prostate gland is smaller than normal, and is of a firm fibrous consistence. The intraglandular stroma is increased in amount, the whole organ being of a sclerotic nature. When the middle lobe of the prostate is especially involved, a fibrous sclerotic bar is produced, which mechanically leads to interference with the voiding of urine from the bladder, and a severe degree of retention may result. When sections of the gland, the site of chronic interstitial prostatitis, are examined, the appearance seen is very comparable to those observed in a cirrhotic kidney or liver. The glandular tissue is compressed and atrophied by strands of fibrous tissue amidst which portions of degenerated muscles are situated. Throughout the stroma areas are present where small cells, mainly of the lymphocyte type, are accumulated, such as are constantly observed in processes of a similar nature elsewhere. From the point of view of its morbid anatomy, the prostate gland in which chronic interstitial prostatitis is present differs in almost every respect from that in which chronic lobular prostatitis has occurred. It is, perhaps, its misfortune that the only features it shares in common are the clinical indications of prostatism that are so closely similar as to tempt certain surgeons to treat them by a similar operative technic, with occasionally disastrous consequences.

In chronic interstitial prostatitis there is no production of a false capsule such as renders the enucleation of the diseased tissue simple in the hypertrophied gland. If enucleation be attempted, it is only possible by separating the gland from its sheath, a process

of the utmost difficulty and attended with the greatest danger. There is likewise no intravesical herniation of the gland through the fibres of the internal vesical sphincter, nor is there displacement of the ejaculatory ducts and seminal vesicles backward into a region of safety. As a result of this, where enucleation is attempted by blind dissection from above, the internal vesical sphincter must of necessity be destroyed, and the ejaculatory ducts must be seriously damaged, the prostatic veins wounded, and the pericapsular lymph-spaces opened up.

CARCINOMA OF THE PROSTATE

According to Young's most recent statistics completed from cases in his own clinic, one case in five of prostatic enlargement causing obstruction in old men is due to cancer. Out of the 134 cases investigated that form the basis of this communication, 14 showed carcinoma of the prostate to be present, or approximately one in ten. The clinical records of fully an equal number of cases of cancer treated by palliative measures, the prostate not being removed, exist, but, as no material was available for investigating the morbid anatomy, they are, of course, not included; but they go to further confirm the accuracy of Young's statement of the frequency of prostatic carcinoma. In 10 of the 14 cases, prostatectomy was performed, and in 6 of them chronic lobular prostatitis was also present, and had obviously existed antecedent to the onset of cancer, and probably predisposed to its development.

Although the local changes in these three lesions enumerated are so dissimilar, the effect of their presence and the damage they produce are essentially identical, as these owe their origin to the mechanical interference with the outflow of urine and the consequent backward pressure on the urinary tract above that results. This damage is indicated by changes that are mechanical and vital. The bladder becomes dilated and hypertrophied; diverticulae may form. The functional sphincters guarding the lower ends of the ureters are broken down. These channels become dilated. The renal pelvis are distended; hydronephrosis results. The undue pressure upon the renal parenchyma results in pressure atrophy of it. Interstitial nephritis is produced, or, if previously present, is aggravated. The function of the kidneys being to eliminate from the body those poisonous waste products developed by catabolic processes of the tissues, these latter are retained within the system, poisoning the

FIG. 3.

Urinary tract from a fatal case of untreated prostatism due to prostatic hypertrophy (chronic lobular prostatitis), showing extreme hypertrophy of middle and lateral lobes of prostate, with only the slightest degree of intravesical projection around the urethral orifice.

Note the extreme degree of backward pressure as indicated by the hypertrophy of the muscular coat of the bladder, the opening of a large diverticulum of the posterior wall of the bladder, the extreme dilatation of the ureters and renal pelvis, and atrophy of renal secreting tissue. A few abscesses are present in the left kidney substance from acute consecutive suppurative nephritis ("surgical kidney").

History of the Case.—R. H., aged 57. Admitted ten days prior to fatal termination, suffering from extreme prostatism, as indicated by frequency of micturition. He had to rise three or four times during the night to empty his bladder. On admission he looked extremely ill and was collapsed. The bladder contained ten ounces of residual urine. The patient gradually sank and died from heart-failure without operative treatment. The postmortem examination showed the appearances figured in photograph, some anthracosis and dilatation of the heart.



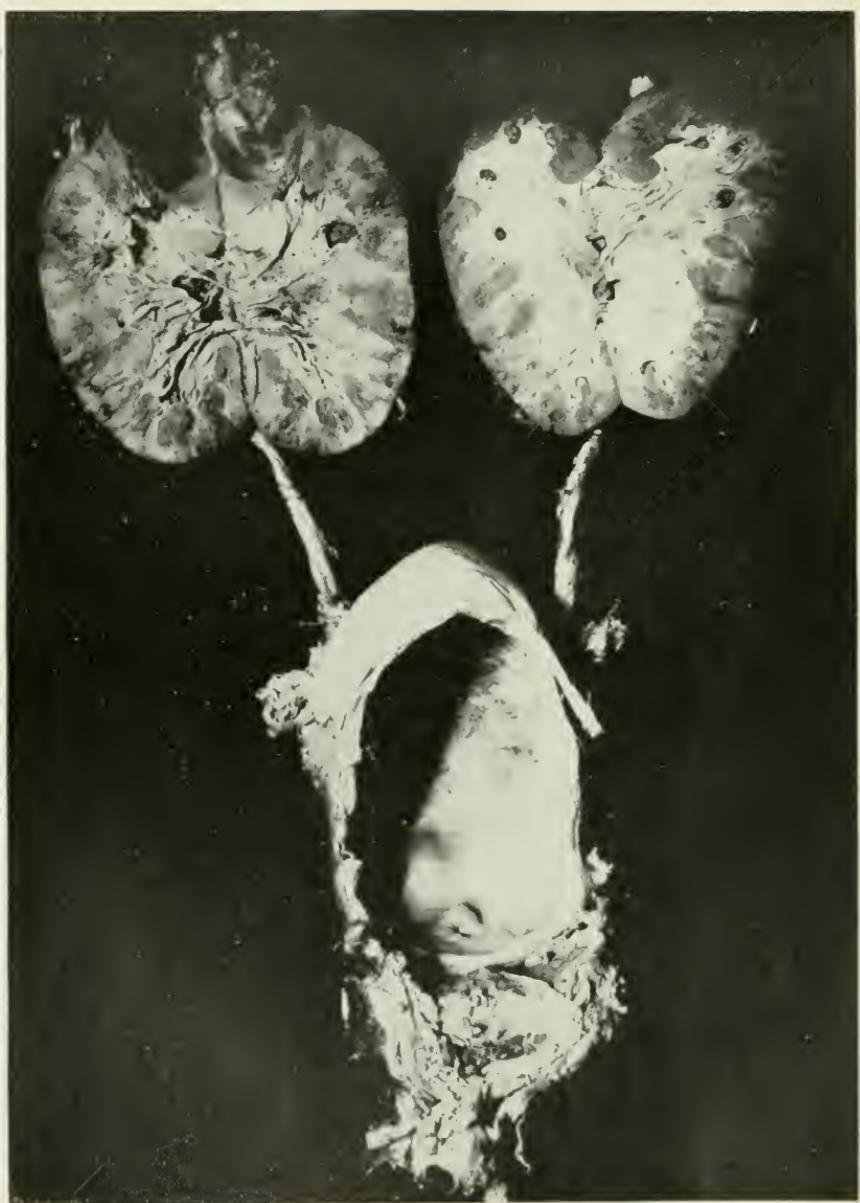


FIG. 4.

Urinary tract from a fatal case of untreated prostatism due to prostatic hypertrophy (chronic lobular prostatitis), showing hypertrophy of prostate gland without intravesical projection or herniation. Note, however, the pronounced degree of backward pressure—dilatation of bladder, moderate dilatation of ureters and renal pelvis, and acute consecutive suppurative nephritis. Numerous abscesses were scattered throughout the substance of both kidneys, and had formed a perinephritic abscess on the left side.

History of the Case.—W. B., aged 57. Patient admitted to hospital 13 days prior to fatal termination of illness, suffering from acute retention of urine. He was extremely anemic owing to loss of blood from hemorrhoids. He was catheterized twice daily, and on the fifth day after admission he had a rigor and temperature went up to 102°. After that day he had several rigors; his temperature was irregular and his lungs showed evidences of bronchitis. Postmortem examination revealed the appearance shown in the photograph of the urinary tract, with evidence of pronounced degeneration of heart and liver.

patient and lowering his power of resistance to disease. The bladder in which the stagnant urine is retained ultimately becomes infected, and cystitis results. As a result of this inflammation of the bladder wall, the non-absorptive power of its epithelial lining that exists in health is destroyed. Further, poisons are absorbed into the system, some of which are the products of bacterial disintegration, others being contained in the urine.

In the case that is untreated two modes of death are thus commonly met with. In one, owing to the damage to the kidneys as excretory glands, the patient is slowly poisoned, and gradually breaks up, or, on the other hand, he is carried off by a sudden renal infection, the infection being carried from its primary situation in the lower urinary tract by the blood stream, the lymph stream, or urinary channels to the kidney, and there gives rise to multiple minute abscesses, acute consecutive suppurative nephritis, or surgical kidney, as it is sometimes called.

Before treatment for the relief of prostatism is undertaken, we have next to consider why these diseases give rise to backward pressure, so that we may discover whether it is possible, by the employment of means other than operative interference, to prevent this.

In the normal healthy male the bladder outlet is guarded by two sphincters. One is the internal vesical sphincter, that is formed from the inner circular fibres of the bladder condensed around the urethral orifice on the upper surface of the prostate gland. This consists of non-striped muscle-fibre, and, by its tonic contracture, is the main factor responsible for the retention of urine in the healthy bladder that is not overdistended. The other sphincter consists of striped muscle-fibre, that is known as the external vesical sphincter, or Wilson's or Guthrie's muscle. It is situated around the apex of the prostate, at its junction with the membranous urethra. Its function appears to be that of an accessory guard, that is called into action by voluntary effort, when the necessity arises of retaining urine in a cavity that is fully distended. The act of micturition may be either a purely reflex unconscious phenomenon, or be produced by a conscious desire to micturate. This latter depends upon the vesical pressure and a certain active reaction of the muscles of the bladder to its content. It is important to remember that micturition is excited by the pressure to which the walls of the bladder are subjected, and not to the varying degree of their distention. The mech-

anism of micturition as excited by desire is a lowering of tone or active relaxation of the internal sphincter, which, instead of opposing, promotes the contraction of the detrusor muscle. The third variety of normal micturition is where the action is purely voluntary and is accomplished without desire. It is explained by the cerebral motor centres voluntarily inhibiting the action of a spinal centre which exerts a tonic action upon the internal sphincter of the bladder, and relaxation or expansion of this muscle permits a few drops of urine to trickle into the first part of the urethra, which act on the sensory endings of the mucosa. This sensation then produces reflex contraction of the detrusor, which is followed by evacuation.

The manner in which prostatic disease may induce retention of urine varies. In chronic lobular prostatitis, or prostatic hypertrophy, owing to the intravesical herniation of a portion of the middle lobe, this may form a ball valve and obstruct the channel. Certain cases of extreme backward pressure arise in this manner.

In all chronic prostatic disease producing dysuria the internal vesical sphincter is damaged. In prostatic hypertrophy it is usually stretched by the herniation through its fibres of the intravesical projection. In interstitial prostatitis it is sclerosed from fibrous bands fixing it to the cirrhotic prostate. In carcinoma, in addition to both of the above changes, it may be infiltrated with disease. As a result its function is impaired. It is probable, however, that the main cause of retention of urine in cases of prostatism is due to the development of a mass of what is really foreign tissue that surrounds the prostatic urethra, which is transformed from a muscular tube to a passive channel lined by thinned mucous membrane, the enervation of which is probably defective. As we have already seen, the normal voluntary act of micturition is dependent on a reflex stimulus arising from a sensation originating in this region. In the majority of cases of prostatic hypertrophy, or chronic lobular prostatitis, the appearances seen on urethroscopical examination demonstrate the changes described. The internal vesical sphincter does not appear as a contractile ridge, but is replaced by a white and glistening projection which extends into the bladder and reaches down the prostatic urethra, meeting on either side like tonsils enlarged from acute quinsy when viewed from the mouth. If the bladder is overdistended in cases of prostatism, its sensibility is impaired and there

follows, in consequence, a diminished reflex excitability which aggravates the backward pressure. It seems also rational to assume that the intrinsic enervation of the bladder wall must suffer from partial absorption of poison into it that takes place where its permeability is increased by the chronic catarrh that occurs in association with persistent partial retention of urine.

TREATMENT OF PROSTATISM

The treatment of the patient who suffers from prostatism varies widely with the nature of the disease to which it owes its origin, and is influenced largely by the general health of the patient and his power to successfully endure surgical operation. Whatever method be employed, however, it is safe to assert that the radical treatment of prostatism in its earlier manifestations is at present unpractised. It is worth while considering, however, whether such a course is ever warranted and gives prospects of being generally adopted in the near future.

Before discussing the merits of the various methods of treatment that are practised, I would enumerate the more important of these. The methods available are:

(1) *Forced Voluntary Vesical Contraction*.—This is a method recently advocated by Mr. Miller, and is based on the assumption that the quantity of residual urine in the bladder of a patient suffering from prostatism is accounted for largely by the absence of sustained effort to empty that cavity. He claims that, by the adoption of his advice, the amount of residual urine may be reduced to a virtual negligible quantity, and the patient's comfort much increased and his life prolonged.

(2) *Catheter Life*.—The benefit of this method of treatment and the risks with which it is associated are widely known. All I need say is that "the pitcher that goes to the well is broken at last."

(3) *Castration*.—This method of treatment is now abandoned. It was based on the assumption that prostatic hypertrophy could be relieved or cured by removal of the testicles, the assumption being that the absence of the internal testicular secretion induced prostatic atrophy in these cases. Richardson has shown that in animals that have reached nubility this is not the case, and clinically it was frequently demonstrated that the benefits of this operation were slight as compared with the dangers with which it was associated, not the

least important of the latter being the induction of melancholia as a result of this mutilating operation.

(4) *Vasectomy*.—This operation is also abandoned. It owed its origin largely to the melancholic results already referred to, and had for its object the interruption of the path of external secretion of the testicle and, at the same time, the preservation of the internal secretion. In practice it proved to be valueless.

(5) *Suprapubic Extraperitoneal Transvesical Prostatectomy* with removal of the prostate gland by blind dissection with the finger. This is the operation most widely known as Freyer's operation, and still generally practised in this country.

(6) *Suprapubic Transperitoneal Transvesical Prostatectomy*.

(7) *Perineal Prostatectomy by Open Dissection (Young's Operation)*.

(8) *Perineal Prostatectomy with Blind Dissection (Ferguson's Operation)*.

(9) *Per Urethral Division of the Prostatic Constriction by Galvanocautery (Bottini's Operation)*.

(10) *Per Urethral Removal of the Prostatic Constriction by Punch (Young's Operation)*.

(11) *Perineal Cystotomy with Division of the Prostatic Constriction*.

INDICATIONS FOR TREATMENT AND THE CHOICE OF OPERATION

When it is established that the pathological lesion of the prostate gland exists giving rise to backward pressure and partial retention of urine, it is then necessary to determine whether operative treatment is indicated and, if so, which of the various methods are to be employed, and, finally, whether the patient can successfully endure such treatment with the minimum of risk to life. In the early case the question at once arises, Should operation be recommended, or should treatment be deferred until more serious discomfort is experienced by the patient? In favor of early operation is the obvious fact that the patient's health is little, if at all, impaired, his bladder is clean, his kidneys are undamaged, and his body generally is unpoisoned by retained products of the tissue catabolism. At the same time, I question whether there are many who are at the present day prepared to recommend operative treatment at so early a stage, and this for two reasons, the more important of which is the high

mortality attending it, and the other is the belief that chronic prostatic disease producing prostatism can exist in many men for years, giving rise to little discomfort, and interfering little, if at all, with an active and useful life, and be associated with little danger to health. The first reason should have little weight with the surgeon. The operative treatment of prostatism when performed by a competent operator owes its mortality almost entirely to the advanced stage at which the treatment is carried out, the bladder being usually infected and the kidneys almost constantly seriously damaged. If, on the other hand, these cases had been operated on at an early stage, the risks of such treatment should be little, if at all, greater than the removal of the vermiform appendix when disease in it is quiescent. The other reason is, on the other hand, of very great importance, because, so far as I am aware, it is true in many cases. In how many is unknown.

In the very early case, therefore, where prostatic disease has been discovered, as it sometimes is, almost by accident, or owing to the presence of an acquired hernia, with which it is associated, it is justifiable to advise that operative treatment be not at present considered advisable, but if the residual urine be not reduced to under two ounces, despite the efforts of the patient to empty the bladder completely at each act of micturition, or if evidences of increasing backward pressure show themselves, as indicated by increased muscular hypertrophy of the bladder wall, or signs of vesical catarrh, or failing health, with loss of weight, the operation should most certainly be then advised.

It now remains to be considered which operation to choose, and whether the patient is in a fit state to withstand the same. The first question cannot be answered without a complete examination of the patient, including a careful urethroskopical and cystoscopical examination. If, when these are carried out, the prostate is found to be hypertrophied with an intravesical herniation of its middle lobe, the simplest treatment is suprapubic prostatectomy according to Freyer's method. An equally good result can, however, be obtained in such cases by a perineal prostatectomy, especially by Young's method. This, however, demands a knowledge of the technic of the operation that many do not possess, and, what is even more important, the possibility of the after-treatment being in the hands of those competent to carry out this stage with a detailed thoroughness

and accuracy that is essential. If the latter be not possible, a suprapubic prostatectomy is the safest course to follow. If hypertrophy be present without intravesical herniation, as is sometimes the case, Young's operation is undoubtedly the best. Prostatic fibrosis associated with the presence of a sclerotic median bar producing prostatism is best treated by removing the same by means of Young's prostatic punch. The treatment of prostatic carcinoma depends upon the stage it has reached. In an early case, the one most suitable for radical treatment, the diagnosis is frequently very difficult, but where the indications of prostatism have rapidly developed, the patient has failed rapidly, and where a suspiciously hard nodule is felt in the substance of one lobe, that is associated with an irregularity in contour observed on urethroscopical examination, and over the surface of this the mucous membrane of the prostatic urethra is fixed and possibly ulcerating, the indications point with a tolerable certainty to the presence of a centrally-situated malignant new growth. The removal is justified in such a case, and can be best executed by its total extirpation from the perineum.

The case of prostatic carcinoma that is obvious clinically is practically inoperable, and the most that can be hoped for is to prolong life by the performance of a suprapubic or perineal cystotomy.

It now remains to be considered whether the patient is in a fit state to withstand the risks of operation. It is, first of all, necessary to determine the functional activity of the kidneys. The simplest way to estimate this is by the amount of urea excreted. If the patient, being on a normal diet, is passing from 400 to 500 grains of urea in the 24 hours, it is safe to assume that the kidneys are functioning well. This rough-and-ready estimate, although of value, is despised by physiological chemists and discarded by the expert, who prefers the most recent test of functional activity introduced by Gerratry and Rountree, the phenolsulphonthalein test. When this is employed, and the patient is found to excrete over 60 per cent. of the pigment within two hours, it is safe to assume that the kidneys are satisfactory. The presence of cystitis contraindicates immediate operation. Irregular action of the heart does not contraindicate operative treatment, but makes the prognosis much graver. The most unlikely subject can frequently be brought into a fit state for operative treatment by a prolonged preparation which consists of rest to the bladder by continual drainage, fluids in excess to

almost waterlog the patient, rest in bed, and a cardiac tonic. In cases where a pronounced cystitis exists and the patient is feeble, a preliminary suprapubic cystotomy is recommended by some. The benefit of this is problematic.

The accompanying illustrations, made from three consecutive cases of prostatism due to chronic lobular prostatitis (prostatic hypertrophy), that died without operative treatment, demonstrate the serious consequences of unrelieved backward pressure. In all of them the patients first came under the care of the surgeon a few days prior to their death, and were, from the point of view of surgical treatment, hopeless cases from the first. Owing to long-standing backward pressure, the function of the kidneys had been largely destroyed. In consequence, the patients had undergone a progressive poisoning by the retained products of metabolism, that should have been excreted by the urinary tract, so that their power of resistance to infection was very much reduced, and they all succumbed to an ultimate acute infection producing multiple abscesses throughout the kidney substance, and rapid acute poisoning by the products of bacterial disintegration.

They also illustrate three distinct types of cases that are met with in chronic lobular prostatitis (prostatic hypertrophy). In Fig. 1 the enlarged middle lobe has herniated itself through the stretched fibre of the internal vesical sphincter, and has formed a large intravesical projection. When such a case is met with before the patient's strength is undermined by prolonged backward pressure, it is ideal for treatment by suprapubic enucleation, according to Freyer's method. In Fig. 3, made from the second case, the enlarged prostate is almost entirely extravesical. Although the gland is much enlarged, there is only a very slight degree of intravesical herniation of it. This case illustrates that very severe backward pressure may develop although no intravesical projection is present. In Fig. 4, made from the third case, the prostate gland is enlarged and there is an entire absence of herniation of it into the bladder. It is entirely extravesical. These two last cases illustrate a type of prostatic hypertrophy that is frequently met with. Suprapubic enucleation of the gland by Freyer's method is possible, but difficult, dangerous, and not advisable. They are cases that can be most suitably treated by perineal prostatectomy, according to Young's method, the immediate risks to life of this operation being less and the ultimate prospects of a permanent and speedy cure being better.

THE TREATMENT OF SYPHILIS OF THE NERVOUS SYSTEM

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THE therapy of nervous syphilis in recent years has formed one of the most interesting topics in the realm of medicine. It is necessarily intimately related to the treatment of syphilis in general, and, in any discussion of the former, the latter comes in for important consideration. The great impetus which this subject has received is due to our wonderfully increased knowledge concerning syphilis itself. Our best and most scientific information in regard to it has been acquired in the last decade. Starting with the discovery of the causative factor, the Wassermann reaction, Ehrlich's new spirillotrope salvarsan, one important discovery has followed another in quick succession. Salvarsan and the Wassermann reaction, in the period of a very few years, have revolutionized our treatment of this disease. As with all advancees in medicine, they have been praised by some and severely criticised by others. A thorough discussion of their good and bad points is quite essential to a clear understanding of their intelligent application in specific therapy.

The administration of salvarsan is not entirely devoid of danger, as the numerous reports of fatal cases within a few hours or days after its injection show. The causes of death do not always appear to have been the same. In some cases the post-mortem has revealed an encephalitis hemorrhagica, in which there are found a high degree of hyperæmia and swelling of the brain and meninges. Such cases have been regarded as due to acute arsenic intoxication. In other cases, where the specific lesion has been in the neighborhood of vital centres, as notably in the case of cervical meningomyelitis reported by A. Westphal and Stertz, where the salvarsan transformed a chronic condition into an acute one and caused the death of the patient, the cause may be attributed to the Herxheimer reaction occurring in the lesion. On account of the severity of this reaction at times, in cases of recent syphilis where much headache is complained of and where

vital centres are affected, such as the medulla and upper cervical cord, salvarsan would seem to be contra-indicated.

The great disappointment in regard to salvarsan was in its failure, by one large dose, to make a complete sterilization of a syphilitic patient. When Ehrlich's idea of a *therapia sterilans magna* was conclusively shown to be a failure, numerous debatable questions soon arose in regard to its use and value. The very fact that it was an arsenic preparation made many suspicious of it and interfered with its continued administration over long periods of time in the way we give mercury and potassium iodide. The appearance in numerous patients who had been treated with salvarsan of certain symptoms which we had neither been accustomed in the former methods of treatment to observe so often nor so early in the course of the disease helped to increase this suspicion. These symptoms are spoken of as relapses in nerve-tissue (neurorecidivé), and are often manifested as cranial nerve paralyses, although they may occur almost anywhere in the nervous system. These paralyses seem especially to have affected the seventh and eighth nerves.

Finger, of Vienna, was one of the first to observe the greater frequency of these nerve paralyses and to attribute their cause to the toxic effect of the arsenic. Ehrlich, on the other hand, explained their occurrence in a different way. He said they were not due to the toxic effect of the arsenic, but were caused by isolated foci of spirochætes. They occurred most often in the cranial nerves because these nerves ran a tortuous course through bony canals and foramina where the circulation was often congested, and, therefore, inaccessible to the action of salvarsan. The spirochætes in the body in general were destroyed by the action of the salvarsan, but here and there where the circulation was impeded and the salvarsan did not penetrate isolated foci of the parasites were left. The escape of these isolated foci from destruction was not due to any fault of the salvarsan in failing to act as a spirillotrope, but should be considered rather as a physical one. In support of this view, attention was called to the fact that in most of the cases where nervous relapses were observed the four reactions were found to be positive, and, also, the administration of either more salvarsan or some form of mercurial treatment caused them to disappear. As a further proof of this explanation, it was stated in the later manifestations of syphilis, such as tabes and paresis, where

the nervous system is regarded as less resistant and more easily affected by toxic substances, and in other diseases where salvarsan was administered, such as relapsing fever, anæmias, etc., they were not observed.

In regard to this view of Ehrlich's, H. Oppenheim says it may probably be considered as in part true, but further experience has caused him, with other observers (Nonne, Finger), to believe that these early cranial nerve paralyses are also due to the injurious effect on the nervous system of salvarsan, which renders it more susceptible to an invasion by the spirochætes. Both of these explanations sound plausible, but they cannot both be correct, and neither one of them coincides at all points with the clinical observations. Ehrlich's theory assumes an invasion of the cranial nerves which have caused no symptoms before the giving of the salvarsan, and the theory of Finger and Oppenheim does not agree with the more frequent occurrence of these nervous relapses in the early stages of syphilis and their absence in the tertiary.

Another factor which has not been taken into consideration in the theories just mentioned, and which seems to agree better with our clinical experience, relates to the question of immunity. Gennerich says there exists a very evident antagonism between an active secondary syphilis and monosyphilitic symptoms. A proof of this statement is shown in the healing of the initial lesion without treatment (when it has not healed before) at the beginning of the secondary stage. There is every reason to believe that during the secondary stage the immunity of the patient to react against the specific infection is developed. This existence of immunity explains latent syphilis. The great majority of our cases of tabes and paresis occur in patients who can give no history of secondary symptoms. Their system, therefore, has not developed the hypersensitiveness necessary to react against the syphilitic virus, and tabes and paresis are the final result.

This theory of a feeble immunity, because of either mild, secondary, or no secondary symptoms, as an explanation of later nervous involvement, has merit. It would appear more rational as an explanation for the absence of paresis in certain uncivilized countries where syphilis is prevalent, and severe bone, mucous, and skin lesions frequent, than Krafft Ebing's syphilis and civilization. Sal-

varsan administered in insufficient doses to complete sterilization in early syphilis either prevents or causes to disappear the secondary symptoms, and, therefore, takes away from the syphilitic his opportunity of building up a natural defence, which is very important in limiting the further encroachment of the disease. Considered from this point of view, the result accomplished by an insufficient salvarsan therapy in early cases is that the disease still exists in scattered foci throughout the system, and the system is less able to resist its further extension because of its feeble degree of immunity.

We see the same situation existing in other diseases where the excitation for the development of immunity is suddenly removed, as, for instance, in cancer. If the breast is removed for carcinoma and cancer-cells are left in the surrounding tissue, an extension by metastasis is much more rapid and, according to my observation, an involvement of the nervous system more frequent than if the cancerous breast has been permitted to remain. In our endeavors to sterilize the system in syphilis by the arduous and persistent administration of spirillotrophic agents too little attention has been paid to this exceedingly important subject of immunity. It applies, however, more especially to the early stages of syphilis than to the tertiary, where some degree of immunity has had an opportunity of developing.

In early syphilis, then, where salvarsan has been administered once, a most serious obligation would seem to be laid upon the physician to follow it up in such a thorough and persistent manner that a complete eradication of the disease results; otherwise, our present experience would cause one to feel that we had rendered our patient much more susceptible to an early involvement of his nervous system. It is rather too soon to say, from clinical experience, whether a patient so treated will be more liable to develop tabes and paresis. Logically he would, and G. Steiner has been able to report two cases of paresis in patients who received an apparently sufficient salvarsan treatment within a comparatively short time after their infection.

In the treatment of nervous syphilis our recent progress has opened up still more interesting problems for solution. The Wassermann reaction in the blood and spinal fluid and the globulin reaction and lymphocytosis in the spinal fluid are to be regarded as of the very greatest importance in the advancement of our therapy. These reactions not only enable one to judge from time to time of the success

of our treatment, but, better still, they furnish us with a more accurate and certain means of diagnosis and enable us to make much earlier diagnoses. The success of a therapy very often depends on the recognition of disease in its incipiency. These methods of examination in the blood and spinal fluid enable one to recognize the very beginning of a specific involvement of the nervous system. The finding of these reactions quite regularly in the blood and spinal fluid in cases of tabes and paresis, together with Noguchi's announcement of the discovery of the specific parasites in the spinal cords of the former and the brains of the latter, has been of immense value from the standpoint of treatment. We now know definitely the cause of these diseases and some, at least, of the difficulties to be overcome in order to fight them successfully.

With regard to the four reactions in the treatment of cerebro-spinal syphilis: It is quite important that they should be taken from time to time during the course of the treatment, and the treatment continued until all four of them are negative and remain so. Only then may we be permitted to speak of an objective as well as a symptomatic cure.

The value of the Wassermann in therapy is well illustrated in the following case:

Mr. M., aged forty-three; married; syphilis ten years ago; treatment at the time of the infection consisted of mercury and potassium iodide internally for about one year; no children; wife has never been pregnant; has been apparently perfectly well until the beginning of present trouble; in February, 1911, after a slight attack of influenza, experienced some pain in region of right sciatic nerve; the pain and discomfort in limb gradually increased; the physician who treated him ten years before for his syphilis prescribed for him 25 drops of a saturated solution of potassium iodide three times a day, thinking his sciatic trouble might be associated in some way with his former syphilis; after three weeks' medication and no improvement this treatment was abandoned and the patient referred to me for the injection of the sciatic nerve. At the time of my examination patient was somewhat reduced in strength and weight because of the severe pain he suffered. He could neither sit nor lie down with comfort. The only somatic signs presented were some atrophy of the muscles of the right leg, slight sensory disturbances, chiefly limited to foot, loss of strength, and absence of the Achilles jerk. The Wassermann reaction in the blood was strongly positive. While the positive Wassermann did not necessarily mean that the disease in the sciatic nerve was a specific one, taking into consideration that the nerve trouble was of such a character as syphilis might cause, these two facts together formed very strong presumptive evidence that the nerve trouble was due to lues, and the former specific treatment had not been intense enough to cause it to yield. The

patient was given four intravenous salvarsan injections, of five decigrammes each, at intervals of two weeks, with injections of salicylate of mercury in between the salvarsan. In spite of this treatment little improvement was shown by the patient, and the Wassermann was still positive, although not so strong as at first. After the sixth salvarsan injection the patient was able to definitely announce that his pain was better. He had never been exactly certain of it before. The mercurial injections were continued, the improvement continued, and, about one month after the last salvarsan, the Wassermann became negative. The patient made a good recovery and has since remained well. In this case the Wassermann aided materially in making a doubtful diagnosis reasonably certain and encouraged the continuance of a treatment in spite of absence of improvement long after a period when it should have been expected to show itself if the trouble had been a specific one.

The following case shows the value of all four reactions:

Mr. T., aged thirty-eight; married; two children, living and well; no children dead; no history of miscarriages; denies syphilis and does not use alcohol; seven years ago had a hemiplegia on left side, accompanied by a nervous irritability and mental depression; spinal puncture at this time showed a positive globulin reaction and lymphocytosis; the diagnosis of a probable beginning paresis was made; patient, however, made a very good recovery and went back to work. About two years after this attack had another hemiplegic attack on the same side; this time patient received mercurial treatment and again made a good recovery; has had at various times between last hemiplegic attack and present one several slight attacks, accompanied by double vision; present attack began in June, 1911, when he again became hemiplegic on left side; had double vision and was unable to control his bladder or rectum; he could not sleep well, very much depressed in spirits, very irritable, and memory was poor.

Status præsens: Patient was poorly nourished, right pupil was larger than left, both reacted sluggishly to light; movements of bulbi free, left side practically helpless; deep reflexes increased on both sides; Babinski on both sides; speech indistinct; provisional diagnosis, paresis before the making of the four reactions; Wassermann reaction in blood, negative; in spinal fluid only positive when 1 Cc. was used; globulin reaction, slightly positive; lymphocytes, 60 1 c. mm. The result of the four reactions changed the diagnosis from paresis to one of cerebrospinal lues and encouraged the beginning of a vigorous specific treatment. The first injection of salvarsan made a marked improvement in the patient. He was given four intravenous injections of salvarsan, five decigrammes each, at intervals of two weeks, together with mercurial inunctions. Except for a partial hemiplegia and some slight weakness of the bladder, patient has made a good recovery and has remained well for two and one-half years. During these two and one-half years he has had five more intravenous salvarsan injections and four courses of mercurial inunctions. The Wassermann in the blood has always been negative.

The clinical picture presented by this patient was a typical one of a hopeless case of paresis, but the four reactions were so different from the reactions usually occurring in paresis that their result alone

gave the encouragement for the vigorous specific therapy which was instituted, and the subsequent course of the case has demonstrated the correctness of their findings. The four reactions should be considered as necessary in the treatment of all cases of syphilis as they are in its diagnosis. They should be an important guide in determining when the specific treatment can be stopped.

In the case reported, an occasional examination of the spinal fluid would have saved this patient from his repeated relapses and his present hemiplegic condition, which is undoubtedly due to scar tissue at the seat of his old lesions. As a prophylactic measure against specific nervous involvement and later developing tabes and paresis, a knowledge of either the presence or absence of the three reactions in the spinal fluid, in any case of syphilis, would seem to be of great importance.

The whole question of the treatment of nervous syphilis and paresis may at present be regarded as simply one of discovering the best means of destroying the spirochætes, wherever they may be located in the nervous system—whether in the meninges or deeply imbedded in the nervous parenchyma. At the present time it would seem to be exceedingly doubtful whether either mercury or salvarsan can be administered in such a way as to exhibit their spirillo-trophic effect in all parts of the nervous system. Our failure thus far to influence to any marked degree the course of either tabes or paresis, and the numerous reports of brain gummata which have proved refractory to specific treatment, would indicate this.

The method of administering these agents through the medium of the blood alone, although done in the most intensive manner, has shown its inefficiency when the nervous parenchyma has been thoroughly invaded. The recent efforts to utilize the spinal fluid as a further means of rendering inaccessible spirochætes accessible to these curative agents is extremely interesting. The experiments of Swift and Ellis in monkeys and of Marinesco in humans of intradural injections of neosalvarsan have shown that this agent, even when injected in very weak solutions, is so irritative to the nervous system that its use in this manner is not to be advised. The further experiments of Swift and Ellis with the intradural injection of salvar-sanized serum (blood-serum taken from a patient who has received an intravenous injection of salvarsan one hour before) offers hope at

the present time of increasing our efficiency in specific therapy. These observers have proved that the three reactions in the spinal fluid are more strongly influenced when the salvarsanized serum is injected intradurally along with the intravenous injections than they are when the intravenous injections alone are given. The clinical course of the patients so treated has also been encouraging.

Bonhoeffer, following the suggestion of Swift and Ellis, in the use of salvarsanized serum into the spinal canal, in order to bring the salvarsan more directly into contact with the spirochætes in paresis, has begun the injection of this serum directly into the subarachnoid spaces and ventricles of the brain. He injects 20 Cc. of the undiluted serum in this manner. He is unable at the present time to make any definite report over the value of this method, except that in the patients so treated no unfavorable symptoms have followed the injections.

It has been recognized for a long time that acute infections, both in early cases of syphilis and in paresis, seem to exert a beneficial influence. Recently Pilez and Mattauschek have collected 241 cases of persons in whom some acute infection developed during the early years of their syphilis. None of these individuals afterwards showed any evidence of a nervous involvement. The literature abounds with reports of cases of paresis in which either a standstill or a very long remission has occurred after a severe infection, such as pneumonia, erysipelas, or a suppurative condition.

This knowledge of the favorable effect of a high fever and marked leucocytosis, caused by such acute condition, has furnished a rational basis for the so-called fever therapy in cases of paresis. Wagner, of Vienna, was one of the first who endeavored to artificially produce fever in his cases of paresis. He used Koch's old tuberculin in rapidly-increasing doses, sufficient to cause at each injection a severe reaction. Other means have since been utilized, as the injection of dead staphylo- and streptococic cultures and sodium nucleinate, first suggested by Donath, of Budapest. This method of therapy has been further improved by combining with the fever-producing agent the administration of both salvarsan and mercury. The success of this combination therapy in paresis has led both Pilez and Mattauschek to recommend it in every case of syphilis in which the spinal fluid shows a nervous involvement.

H. Oppenheim, in the sixth edition of his text-book on nervous diseases, in regard to the sodium nucleinate injections, says he has had the opportunity of observing three cases of paresis in which a most striking result was obtained by this method. In one case, which was apparently that of a paretic in an advanced stage of dementia, he could not consider himself justified in recommending any kind of therapeutic procedure, although the friends of the patient were particularly anxious to have him try something. The patient was then taken to another institution and given the sodium nucleinate injections, which caused such a complete remission that he was again able to take up his former occupation as an active officer.

In the past two and one-half years I have had the opportunity of treating ten cases of paresis by this combination method, using either mercury and sodium nucleinate alone or mercury, sodium nucleinate, and salvarsan. Some degree of improvement has been shown in all of these cases except one, and in three cases complete remissions, which are still persisting, were obtained. In one case, where a marked degree of dementia was present and where only mercurial inunctions and sodium nucleinate were given, a large abscess developed in the gluteal muscles after a sodium nucleinate injection. This abscess caused the patient to run a temperature varying from 101° to 103.6° for over a period of two weeks; after the evacuation of the abscess and the subsidence of the temperature to normal, the patient showed a wonderful improvement. He is now enjoying a complete remission, and has returned to his former occupation as an operator of a type-setting machine, in which he has attained his former speed and accuracy.

Pilez, who has obtained remissions in 25 per cent. of the cases of paresis so treated by him, says that, after the administration of the fever- and leucocytosis-producing agent, remissions in much greater frequency, longer duration, and more complete in character can be obtained than occur otherwise spontaneously. Even the simple demented forms, which according to experience show the least tendency to spontaneous remissions, sometimes improve under this therapy. Furthermore, in the same patient repeated remissions may be produced by a repetition of the treatment.

All of these methods of treatment are strenuous and must be given over long periods of time in an intensive manner, and in none of

them can we say in the beginning that we are certain of a cure, nor at the end that our patient will not again experience a return of his disease. The problem of destroying, by spirillotrophic agents introduced into the system, all of the spirochaetes in the central nervous system, after it has been completely invaded by them, is an exceedingly difficult one, and thus far no solution that is entirely satisfactory has been presented.

In our present therapy of syphilis the discussion of salvarsan seems to have obscured everything else. One reads very little about the production of an immunity with a specific vaccine, yet our experience in the treatment of other diseases teaches us that all our best therapeutic successes have come about along this line. Recently Schereschewsky, in the Pasteur Institute in Paris, has succeeded in developing a syphilitic vaccine which is able to protect monkeys vaccinated with it against luetic infection. The injection of this vaccine into rabbits, after about eight days, causes also the production of specific antibodies. It is not at all improbable that a still greater success in the therapy of syphilis awaits us in this direction than any we have thus far attained with either mercury or salvarsan.

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REACTIONS OF DEGENERATION.*

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ELECTRICAL stimulation of motor nerves and muscles results in certain definite physiological reactions when conducted methodically on the living human body. Quantitative and qualitative changes in these reactions are frequently found in certain pathological conditions. We may frequently draw certain conclusions as regards the anatomical relation of nerve and muscle, as regards the exact site of the lesion, and as regards the prognosis.

The instruments needed are as follows:

(1) An electrode having a surface of 2 by 3 inches. (This is to be used as an indifferent electrode.)

(2) An electrode having an interrupting device on its handle, and having a flat contact surface of about $\frac{3}{4}$ inch square. (This is to be used as the active electrode.)

(3) A delicate galvanometer for measuring the strength of the galvanic current while being used.

(4) A regulating device, or rheostat, for adjusting the strength of the current.

(5) A faradic coil of the sledge type; its construction permitting the sliding of the secondary spool over the primary, and having attached a scale measuring exactly the slide of the secondary coil over the primary.

In place of this scale we may use a rheostat, accurately calibrated in ohms to register the strength of the current and the resistance of the part to which the current is being applied.

It is impossible to use a galvanometer to measure the strength of the faradic current.

Let us now consider the laws of muscular contraction. When a muscle is stimulated at a point near its extremity, an elevation is formed at the point of its stimulation. This raised position is a

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zone of contraction which is propagated along the muscle by a sort of undulation. The velocity of this wave of contraction has been found by Ae'by and Marcy to be one to two metres per second. Normal physiological contraction shows no such wave. The contraction occurs *en masse*.

Soon after the discovery of the principle of electromagnetic induction by Oersted, in 1821, and of the effects obtained by such apparatus by Faraday, in 1831, apparatus began to be manufactured which gave current in sufficient volume to excite curiosity and to stimulate scientific investigation. Among these early investigators, the name of Duchenne will always remain prominent. When he began the study of the effects of the faradic and galvanic currents on muscles, he had already done much in the field of neuropathology. His studies and description of locomotor ataxia, of bulbar palsy, of progressive muscular atrophy, of poliomyelitis anterior, etc., are all well known. In these studies the faradic current was to him a useful servant. He published a number of original articles between 1847-1850, wherein his *Faradization localisée*, and *Galvanization localisée*, and his physiological examination of the function of muscles, are detailed. To this were added an abundance of electrodiagnostic examinations of peripheral traumatic palsies, poliomyelitis anterior, etc. Duchenne found that a muscle could be stimulated, by direct faradization from one or more points along its surface, to a complete contraction.

“ POINTS D’ELECTION ”

Remak proved that these points were situated at the entrance of the motor nerves into the muscles. He also showed that it was better, as a rule, to stimulate the muscles by applying the current over the motor nerves than to do so direct.

This stimulated such men as von Ziemssen, M. Meyer, Helmholtz, Erb, and many others to inquire into the laws under which muscles respond to the action of electrical currents. In this way the law of muscular contraction was established.

The appearance of contraction, following opening and closing of the current, varies according to the sign of the active electrode and according to whether the muscle is polarized or not. In testing a muscle we may apply the indifferent electrode on any part of the

body. The small active electrode is applied to the motor nerve or to the point of excitation of the muscle. The electrode should be well moistened. A current reverser and an accurate milliampèremeter should be employed. According to Erb, the muscular contractions appear normally in the following order, as the intensity of the current is raised:

K.C.C.
A.C.C.
A.O.C.
K.O.C.

The contractions on closure (C.C.) are diminished by polarization; whereas the contraction on opening (O.C.) are increased by polarization. The tissues become gradually polarized as the exciting current is increased, and K.C.C. becomes at first superior, then equal to, then inferior to, and again superior to A.C.C.

If we subject a muscle to a series of successive excitations, the contractions become gradually stronger until we reach a maximum. Successive stimulations are superimposed upon each other so that we are enabled to produce a contraction where none appeared at first. When a series of excitations is so rapid that one *secousse* follows the other during the stage of increasing energy, a permanent contraction of the muscle follows. This contraction, apparently permanent, is made up of a series of successive contractions. Above 1100-1200 per second the *limit* of contraction is reached. Beyond 10,000 per second the muscle no longer responds to excitations.

When a muscle is in a state of apparent permanent muscular contraction we say it is tetanized. Forty excitations per second are necessary in man to throw a muscle into a tetanic contraction. To produce tetanus in unstriated muscular tissue the shocks must be separated by longer intervals. This is due to the slower rate of contraction of unstriped muscular fibre. The A.C.C. is also more efficacious than the K.C.C.

With rhythmic galvanic currents, peristaltic contractions of the digestive organs, of the gall-bladder, and bladder are easily produced. It has been found that cooling of a muscle, even within physiological limits, may suffice to produce marked slowing of the response of muscular contraction. Gruend has noted an inversion of the normal formula on the muscles of the hand of a man as the result of a simple

cooling. Warming a muscle results in better reaction. With these fundamental principles in mind we are prepared to investigate those phenomena which Erb has grouped under the name of "The reaction of degeneration." Erb defines this: "An entire cycle of quantitative and qualitative changes of irritability which occurs in nerves and muscles under certain pathological conditions, and presents intimate relations to certain histological degenerative changes occurring in these structures. It is characterized in the main by diminution and loss of the faradic and galvanic irritability of the nerves and the faradic irritability of the muscles; while the galvanic irritability of the muscles persists, is sometimes considerably increased, and is always changed in a definite manner."

We begin by comparing the relative resistance to the faradic current of the two sides, right and left arm, for instance. The sledge coil now in common use can be regulated by sliding one coil over the other; or we may place a regulated rheostat in the secondary circuit with the galvanic current. Our milliampèremeter is our best guide.

The patient should be placed in a horizontal position, or on a chair with a back. He should relax his muscles and be in a state of complete repose. The indifferent, well-moistened electrode is placed on the spine, either at the neck (if the arms are to be tested) or in the lumbar region (if the legs are to be examined). The weight of the body or a bandage may be utilized to hold the electrode in place. The operator, seated near the patient, within reach of reverser, rheostat, etc., applies the exploring electrode to the motor points of the muscles and nerves to be tested. He now proceeds in a systematic manner to explore. Commencing with the faradic current, in order that the tissues may not be polarized at the very beginning, we soon get a general idea of the behavior of muscles or nerves. For, if the faradic contractility is not altered, the probabilities are that the galvanic contractility is also normal. Usually we attach the exploring electrode to the negative side of the secondary current. It is not necessary now to compare the action of + and -. We begin with the sledge or rheostat at the point where the least current is given off. The current is now increased until the maximum contraction is reached. This is carefully noted.

The motor point is found by trial, by moving the electrode about

until the exact position is found. We compare healthy and diseased sides. Sometimes it is difficult to do this satisfactorily, on account of contractions in neighboring muscles. Duchenne's method, which consists of applying an electrode at either end of a muscle, may get us over the difficulty.

We then proceed to the galvanic current, bearing in mind the normal formula. We keep our finger on the interrupter and allow the current to pass at intervals for one or two seconds. When the first contraction of the muscle appears, we are careful to note or write down the exact current strength needed to effect this. For instance, in facial palsy:

K.C.C.	2	m
A.C.C.	3.5	
A.O.C.'	4.7	
K.O.C.'	5.5	

When no response is obtained with the usual electrode at 15 m., we should refrain from further attempts, as the burning and pain become excessive.

We place the electrode on the lower tendon of the muscle, instead of the motor point. We may now proceed as before, and obtain a response. This is called the longitudinal reaction.

There are certain anomalies of contraction:

(1) *Faradic Hyperexcitability*.—This usually occurs where the tendon reflexes are exaggerated. Instances are: writers' cramp, recent cerebral palsies.

(2) *Faradic Hypo-excitability*.—This is accompanied by rapid fatigue of the muscles, which soon fail to react unless the current strength is increased. We meet this in chronic cases of cerebral palsy, old cases of tabes, in primary myopathy. It is also found where D. R. occurs.

Quantitative Changes of Galvanic Contractility. Slowness of Contraction.—(1) Galvanic hyperexcitability, (2) Galvanic hypo-excitability, is met where faradic excitability is diminished or lost. Changes in the order of contraction may be either partial or complete; for instance:

A.C.C. > K.C.C. > A.O.C. > K.O.C.

or there may be found a total inversion of the normal formula:

A.C.C. > K.C.C. > K.O.C. > A.O.C.

In some cases there may be merely an approach of A.C.O. to A.O.C., both contractions occurring with the same intensity. Or the order may be reversed, as in Rich's formula:

$$\text{K.C.C.} > \text{A.C.C.} \gtrless \text{A.O.C.} > \text{K.O.C.}$$

Partial or total inversions of the physiological formula are a part of the symptom-complex of D.R. They vary with the degree and development of the lesion.

When a Nerve is Freshly Divided.—For the nerves: Galvanic and faradic excitability increases at first for about three days; then it diminishes until about the fifth day, when the normal is reached; then continues to decrease until about the tenth day, when it disappears.

For the muscles: Faradic excitability diminishes gradually until it disappears at the end of two weeks. Galvanic excitability diminishes in the first week; then increases until it exceeds the normal in the second week, and persists in an exaggerated state till all the other reactions are abolished. Then muscular contraction becomes sluggish and we get mechanical excitability. At the end of the second week we get the phenomenon of inversion, at first partial. A.C.C. occurs before K.C.C., and a little later K.O.C. before A.O.C. After several weeks we have the total abolition of faradic excitability (in the nerve). Lastly, the galvanic excitability diminishes. First A.O.C., then K.O.C., and then K.C.C. disappear, A.C.C. alone remaining. Still later, A.C.C. and, last of all, the longitudinal reaction disappears. R.D. is met with in poliomyelitis anterior, in bulbar paralysis, in ophthalmoplegia, where the anterior cornua or the nuclei of the pons or medulla are affected. It also occurs in neuritis and polyneuritis. In all cases of primary myopathy there is an absence of R.D., except in the Charcot-Marie type, which is probably due to a central lesion. There is, however, a diminution of galvanic and faradic excitability. The muscles also show the reaction of fatigue quickly. In the final stage all excitability disappears. In muscular atrophy of traumatic type no R.D. appears, unless the nerve is injured.

In neuritis of all types we find a more or less complete R.D. In the cases of alcoholic polyneuritis, which resemble tabes by reason of movement and ocular troubles, electrical examination may help us. We usually find a partial R.D. It usually comes on late in the

course of disease. The sensitive nerves are involved before the motor nerves.

R.D. occurs mostly in the extensor muscles: extensor communis digitorum, extensor proprius pollicis, peroneii, tibialis anticus, the muscles of the foot, and the muscles of the hand. Lead palsy is chiefly motor (the sensitive nerves are but slightly affected), and is accompanied by muscular palsy, atrophy, and early and complete R.D. Here the extensors of the fingers, the deltoid, biceps, brachialis anticus, the supinator longus, tibialis anticus, peroneii, and extensors of the great toe are the muscles usually attacked.

In diphtheritic neuritis R.D. does not occur; merely diminished excitability of the velum palati and pharyngeal muscles. Peripheral facial paralysis is usually due to cold (exposure to draught of cold air). Traumatic facial paralysis results from compression of forceps in labor, syphilitic gumma of parotid, or neuritis. Paralysis (facial) of intra-temporal origin results from syphilitic periostitis or caries of the temporal bone. There is interference with hearing, bitter taste in the mouth, diminution of salivary secretion; palsy due to lesion of the medulla and pons below the crossing of the fibres of the facial and above that of the pyramidal tract, or to an alternating hemiplegia; palsy due to hemorrhage or softening. In facial palsy of central origin no R.D. occurs; in facial palsy due to neuritis R.D. sets in in from six to eight days. If no R.D. occurs at this time, the case will recover quickly; otherwise the duration of recovery will be prolonged. The behavior of the muscles to faradic and galvanic stimulation is here of the greatest importance from a point of prognosis.

Faradic hypo-excitability with galvanic hypo-excitability may be found in old hemiplegia, hysterical palsy, primary myopathies, reflex amyotrophy from disease of a joint, in locomotor ataxia, in disseminated sclerosis, in slight neuritis, in slight rheumatic palsy, or from compression or infection when the spinal centres are not involved.

Galvanic and faradic hyperexcitability occurs in recent hemiplegia, Little's disease, sometimes in chorea. In Thomsen's disease we find a peculiar faradic and galvanic hyperexcitability for both nerve and muscle. The galvanic and faradic are nearly equal, tonic, and prolonged. Anodal and cathodal closure tetanus may occur with a current of from five to ten milliampères, and sometimes anodal opening tetanus. Tetanizing faradic currents causes tetanus, which

lasts for some time after the current has ceased to pass, and we find undulatory contractions in neighboring muscles.

Fusion of successive muscular contractions (myotonia) occurs when the galvanic and faradic current is broken at short intervals, and can be produced with a current strength which would normally produce only isolated muscular contractions. Repeated muscular contractions, either voluntary or involuntary or electrically excited, exhaust the muscles so that myotonia no longer appears. Testing with the galvanic current shows that A.C.C. = K.C.C.

Condenser discharges have also been used for diagnosis. They are said to be peculiarly valuable because they are of such short duration that the resistance of the body does not change. They are unidirectional, painless, and free from electrolysis. Small condensers of $\frac{1}{2}$ to $1\frac{1}{2}$ microfarads are needed.

Pilez (*Neurolog. Centralblatt*, 1904, p. 1019; *Jahrb. Psychiatrie*, 192, Heft 111) has published some observations on changes in muscular excitability in cases of mental disease. He found a distinct prolongation of the contraction in psychoses, from 0.1 to 0.18 to 0.25 to 0.58 second. These changes were most marked in the small muscles of the hand and foot. Those cases of psychosis where marked polyneuritic processes were demonstrable by other methods showed delayed and sluggish muscular contraction. In 21 cases of psychoses (delirium tremens, alcohol paranoia, etc.) he found that 75 per cent. showed neuritic changes, and changes in the electrical excitability of muscles; 32 out of 46 cases of progressive paresis showed diminished galvanic and faradic excitability.

Lenz has found in seven paretics a diminution of faradic and galvanic excitability of nerves and muscles. Sometimes there occurred (in a few muscles and nerves) hyperexcitability. In the terminal stage a partial R.D. was found, especially in those cases where tabetic manifestations appeared. The abnormal reactions appeared more often in the upper than the lower extremities.

Etienne and Perrin (*Neurolog. Centralbl.*, 1907, J. 39) have found, in a case of progressive paresis, disappearance of faradic muscular excitability in the muscles of the right calf of the leg; also diminution of galvanic excitability on the whole back part of the leg. There was no inversion of the normal formula. They also found a normal spinal cord; and arthropathy of the right knee.

Among the disorders in which electrical changes of a quantitative

and qualitative nature are found, neuritis is one. Before proceeding to the utility of electrical currents in the treatment of this disorder, let us inquire a little into the nature of that symptom-complex to which the name neuritis is applicable. It has become fashionable to call almost any pain where the nature of it is not easily explainable neuritis. Neuralgia, for instance, may simulate neuritis; and, indeed, the dividing line is often hard to define.

Again, myalgia, fibromyositis, disease of a joint, or a painful shoulder may have (and, indeed, often has) the appellation of neuritis applied to it.

We have a number of different causative factors which lead us to differentiate several varieties of neuritis:

First.—Traumatic neuritis.

Second.—Neuritis descendens. This may be due to disease of the bony and other structures. For instance, appendicitis may lead to anterior crural neuralgia (neuritis); again, periostitis, callous formations, inflammation of the bony canal, etc., may give rise to it. Or it may be a secondary process brought about by compression; or an extension of an inflammatory process, such as we find in the different branches of the trigeminus or in the fallopian canal; or (as in the case of sciatica) it may be the result of an overloaded condition of the bowel, hemorrhoids, or disease of the prostate, perhaps a carcinoma of the prostate. Again, disease of the uterine adnexa may be a causative factor in sciatica.

Third.—Neuritis ascendens; chronic interstitial myositis may give rise to it. Or it may be the result of the extension upward of an inflammatory process—abscess of the hand, for instance. Neuritis of the optic nerve may start as a retinitis, produced by Bright's disease; or it may be the result of intracranial processes, more particularly those at the base of the skull. Here it would be classified under the designation neuritis descendens. It may result, in this case, from direct compression, or from an extension of inflammation, or from vasomotor disturbance. Tumors in neighboring nerves, carcinomas, may be productive of an extension of inflammation. A carcinoma may extend into the nerve itself and produce destructive changes within it.

Fourth.—Atmospheric influence, so-called rheumatic disorders, may be productive of an exudative perineuritis, as in so-called rheumatic sciatica, facial palsy, etc.

Fifth.—Infectious diseases, like smallpox, typhoid fever, diphtheria, may leave an inflammation in different branches of nerves. *Herpes zoster* is probably an acute specific disease of the central nervous system. Head and Campbell compare *herpes zoster* to acute anterior poliomyelitis. The late Alexander Bruce was inclined to regard it as a posterior myelitis. Whether the eruption is due to an extension of inflammation along the nerves, or whether it is simply a result of an irritative process of the cells of the posterior root ganglia (from hemorrhages or other causes), leading to impulses passing both centralward (thus causing pain) and peripheralward along the nerve-fibre to the bifurcation (which ends in a blood-vessel and there produces a dilatation and subsequent trophic changes in the skin), the resulting clinical picture resembles neuritis.

Sixth.—Gout, lepra, syphilis, tuberculosis, diabetes mellitus.

Seventh.—Toxic influences like lead and alcohol. These may lead to a more or less widespread inflammation of nerves. Aside from the varying degrees of tenderness along the nerves, we may have a greater variety of trophic disturbances (varying with the degree and the intensity of the inflammation); “glossy” skin, atrophy of the hair-follicles, a more or less extensive atrophy of muscles. Pain is also usually present. This will also vary with the degree of inflammatory process and with the nerve or group of nerves affected. From a therapeutic standpoint, we may have to bear in mind that we have:

- (I) Increased vascularity.
- (II) Some exudation of serum.
- (III) Migration of leucocytes.

If we apply a mild static spark directly from the static machine, or a resonator spark from an inductor-resonator attached to a static machine (using the bipolar method with a grounded metal plate to the back), we produce tissue contraction. As a result of this, we squeeze out the multiplicity of new tissue elements and the migrated leucocytes. We relieve stasis and guide both the arterial and venous blood stream into the normal channels. Repair begins to take place. The nerve tubules are freed from pressure. The exudation is dispersed. The blood-vessels recover their normal tone. Normal circulation of blood and lymph supplants the pathological stasis, and improved nutrition results.

The static brush discharge is another most valuable means at our command in the treatment of this disorder. The manner of using it is as follows:

We seat our patient on the insulated platform, at least thirty inches from the prime conductor of the machine. If the patient is a female, we request her to remove all metal ornaments from hair and clothing; also to be particular to remove all articles made of celluloid. We connect the patient metallically to the negative side of the machine, by means of the shepherd's crook to the hand, or metal plate to the back, feet, or other suitable portion of the body.

The *positive* side of the machine is grounded to some good ground connection, such as the water pipe or gas fixture. The wooden stick electrode, made of some soft porous material suitably moistened, or, preferably, a (new) brush discharge electrode made of asbestos and a combination of minerals (known as the de Kraft brush discharge electrode), is attached to a separate ground. The machine is now started and gradually speeded up to its best speed. The electrode is passed, more or less rapidly, over the surface of the body, especially over the bare skin of the part to be treated. For care should be taken that not too many thicknesses of clothing cover the skin, in which case there would be a very annoying prickling sensation. If the machine is running at low speed, in good order, and giving a fair discharge, there will be heard a peculiar hissing sound not unlike that of a distant storm or the rushing of the wind in the air. The sensation is like that of a cool wind blowing over the part, intermingled with a sensation as if hot sand were striking the skin. The hair-follicles will rise, not unlike the condition known as "goose-flesh." As the machine gains in speed the brush discharge will be more and more quiet until the character of the discharge assumes the appearance of a blue pencil. The higher the speed of the machine and the more plates the machine contains, the better will be the discharge.

The therapeutic effect of this is comparable to the effect we described when we spoke of mild static and mild resonator sparks. It certainly is our most efficient weapon in the relief of very many painful conditions attending the different types of acute and chronic inflammation.

To obtain a perfect blue-pencil brush discharge, we should have a machine of about 16 revolving plates. The sliding rods should be

widely separated and the machine should be running at its best speed.

It has been said that the blue-pencil brush discharge is a leakage current. My own interpretation is something as follows: The patient, seated on the insulated platform, is being charged from the Holtz machine, just as any other capacity would be, by the static current. No other machine has as yet been constructed that is capable of generating a current at such a high rate of charge and potential as the Holtz machine. Indeed, no instrument of precision has yet been constructed that will give us even an approximate idea of the number of cycles of which a Holtz machine is capable. It is due to this fact that we are able to charge a patient's body in that peculiar manner which enables us to draw off from him long, percussive sparks. This is, also, the reason why his hair rises; and why the air, for several feet around him, is caused to vibrate.

If we watch a blue-pencil brush discharge in a darkened room, we will be struck by the fact that there are thousands of individual, separate discharges discernible in the violet light.

This violet stream has, intermingled with it, several beautiful colors, notably a greenish light; and if the machine is a powerful one (20-plate) there will also appear distinct streams of reddish color. The entire stream is made up of ultraviolet, blue-violet light, intermingled with many other radiations.

A part subjected to the action of a powerful discharge will soon become tanned, much in the same manner that the skin becomes tanned by the hot sun. Indeed, on a delicate skin a condition closely resembling a sunburn can readily be produced. This is due to the ultraviolet light in part, and also to the stimulation of the peripheral end organs of the sensory nerves, resulting in an active hyperæmia of considerable depth.

Let us come back to the manner in which the patient's body is utilized as a capacity. The patient's body, being charged by this current of extremely high potential and small quantity, is discharged at an extremely high rate of speed.

These separate streams of violet light of which we have spoken give us some idea of the enormously high rate of discharge. As a result of this we obtain a marked sedative action, as is evidenced by the relief from pain and the subsidence of muscular spasm. This rapid rate of charge and discharge sets the tissues vibrating in unison. Increased tissue changes result. To this and (perhaps in a more

limited sense) to the small quantity of ozone inhaled by the lungs and the skin during the administration of the brush discharge is due the improvement in the haemoglobin and in the number of red corpuscles.

This, in turn, would enhance the general oxidation processes of the system. The improvement in the relative output of urea, urates, and uric acid crystals is evidence of this.

Dr. Titus has shown that if we place a piece of glass of *pure cobalt* blue against the skin, and allow an electric light to act on the glass for a few minutes, the skin may be rendered anaesthetic, even to the point of allowing a painless incision to be made.

The blue-violet light coming in direct contact with the skin would fulfil a similar mission during the employment of the blue-pencil brush discharge. Indeed, the relief from pain that has resulted in cases of obstinate neuralgia of the face and the teeth, in cases where competent dentists had been unable to detect the slightest damage to the teeth by reason of decay or bad filling, and even in some where distinct evidence of ulceration and other troubles was present, is explainable only on the basis of all facts previously described.

Women suffering from uric acid diathesis and from intestinal auto-toxæmia will often suffer from pain (a neuritis—call it so if you will), congestive in nature, along the different branches of the trigeminus. A very careful application of the blue-pencil brush discharge over the painful part, together with a general application of the widely-diffused discharge, will usually be rewarded by complete cessation of pain. A few repetitions will often cure cases that have resisted the best efforts of dentists and physicians. I instance these cases to show the way to possibilities in neuritis.

That the blue-pencil brush discharge has marked actinic properties is readily shown. Place an ordinary X-ray plate in the envelope usually used when taking a radiograph and allow the blue-pencil flame to play on it for a moment. Then develop in the usual manner, and a beautiful reproduction of the discharge is had.

We have in this hospital many cases of aleoholic neuritis. It seems singular that, in some cases, alcohol should exert all of its evil influences on the digestive organs: on the stomach, resulting in gastritis (acute or chronic); on the liver and kidneys, resulting in cirrhosis. In others, under exactly similar circumstances, these organs seem to escape, and the peripheral nerves and the central

nervous system are the site of the alcoholic attack. Just why this is we do not know.

Perhaps the circulatory disturbances produced in the abdominal organs, in the brain (the wet brain of acute alcoholism), and in the nerves are responsible. May not the constant irritant effect of the alcohol on the mucous membrane of the gastro-intestinal tract lead to a vitiating of the normal digestive juice; may not this same effect lead to a vitiated activity of the liver-cells and other organs?

As a result of this, poisons not normally found may be produced during the process of digestion. These poisons, in turn, may be a determining factor in the causation of degenerative processes in the nervous system.

An editorial in the *New York Medical Record*, December 13, 1913, points out some of the facts so far known regarding the actual substances that bring about systemic poisoning. Berger and Dale have succeeded in isolating, from ergotoxin, a substance called histamine; apparently identical with the decomposition product histidin, which results from protein disintegration. This produces, when injected intravenously into animals, the typical symptoms of stimulation of the autonomous nervous system; namely, a lowering of blood-pressure, with a simultaneous rise of pressure of the pulmonary artery; spasm of the bronchial musculature; bradycardia; uterine contractions, and diminution of the salivary and lachrymal secretions.

Putrescin and cadaverin are other bases which have been detected in human faeces. They are the result of protein decomposition. With some of these ideas in mind, we have utilized the sinusoidal current, by means of a very large electrode over the dorsal spine and a large electrode over the abdomen. With these electrodes it is possible to use quite a large volume of current. We employ a mixture of galvanic and faradic currents; the latter from a coil of 1000 feet of wire. The rate of alternations employed must be of just sufficient frequency to obtain marked contractions of the abdominal and other muscles, *alternately* with marked contractions along the spine. In this way we really affect the most important muscles of the trunk. Among the muscles exercised are the erector spinal mass, the serratus magnus, all of the muscles of the thorax (especially the abdominal muscles), and, to some extent, the muscles of the shoulders and thighs. No other method of application is capable of exercising so many important muscles at a time.

Let us analyze what this leads to. If we subject a muscle to the action of a slow sinusoidal current, we obtain a contraction which starts slowly; and by a *gradual* effort ends in a most *complete* contraction of which a muscle is capable. During this contraction all of the blood is squeezed out, all of the detritus, all of the used-up venous blood with its CO_2 is forced out of the muscle. With this slowly-swelling contraction no rupture of muscular fibre is possible. A period of gradual relaxation follows, succeeded by a period of rest. During this rest the muscle absorbs fresh arterial blood much in the manner of a sponge. It is then in the best possible condition of nutrition to exert its maximum force, when the current again stimulates it to its next contraction. The result is rapid improvement in volume and tone. Among the most important muscles of the body are the erector spinae muscles. I quote from an article by Dr. J. Madison Taylor: "Should these relax, the diaphragm is lowered and its rhythmic pumping action lessened; regular suction is not maintained; tidal air is decreased; the portal venous system suffers, as well as the systemic veins and lymphatics, and all hydrostatic actions are impeded.

"Nutritive balance, neuronic poise, cerebral efficiency, all depend on the postural factors. Failure to keep the diaphragmatic suction pump at work is followed immediately by more or less waterlogging of the tissues, a dimming of the 'visceral lamps' of life which should be kept always brightly burning."

The method described will do much toward restoring the volume, the tension, and the strength of those muscles necessary to maintain normal respiratory habits, thereby assuring normal oxygenation, normal action in the portal venous circulation.

The improved strength of the serratus magnus and other thoracic muscles, and the stronger abdominal muscles, in addition to those already mentioned, all help in maintaining full action of the thorax and diaphragm.

The upward and the downward pull of the diaphragm, upon "which all the tides of the body rest," is materially aided by having strong auxiliary muscles of respiration. The attitude of patients we see here suffering from conditions of depression powerfully illustrates an exact opposite of the ideal condition we seek to bring about by this method of using the sinusoidal current.

PHYSICAL TREATMENT OF VARIOUS FORMS OF ARTHRITIS

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JOINT inflammations may be classified from their origin or causes as (1) traumatic, (2) gouty, (3) toxic, and (4) infected. Those arising from infection may be subdivided into (a) locally infected and (b) toxic.

The indications for treatment will manifestly vary with the cause and conditions presenting, which renders diagnosis important if the course of treatment is to be most promptly effective.

Traumatic arthritis arising directly from violence is the simplest type and most promptly relieved when fracture of joint structures, bony or ligamentous, or luxations of interarticular cartilages do not complicate the inflammation. Such conditions arise from severe sprains with or without luxations, and, while in themselves not serious at the outset, if neglected are often followed by perplexing and annoying consequences. Luxations of a sacro-iliac joint and of the knee-joint are liable to set up conditions of synovitis, which, under negligent management, may progressively go on to ankylosis or chronic disability.

Thirty years since it was not uncommon to consider a sprained ankle more serious than a Pott's fracture, and it was a matter of frequent comment by the practitioner that it would have been better to have broken the bone than to have sustained a severe sprain, even though neither the ligamentous nor bony structures were involved. Rest, hot applications, and elevation were the then common method of treatment. The modern method of early strapping of the joint to prevent swelling has greatly improved the surgical methods, but these do not compare in efficiency with the modern static electrical treatment of sprains.

No longer is rest prescribed, even by surgeons, in these cases, it having been established beyond question that moderate exercise

of sprained parts facilitates rather than impedes recovery. In synovitis of the knee-joint, however, it is still too often the practice to put the joint in plaster and submit the patient to rest, which, from the writer's observation, has not proved to be good practice.

Traumatic arthroses are properly divided into two classes: simple and complex. Sprains and luxations without injury of bone or ligament, and those complicated by rupture of the ligaments or various degrees of fracture of the interarticular cartilage or the bony parts. The former, in which only rupture of the small vessels has occurred, as indicated by varying degrees of ecchymosis, when coming early under observation, yield promptly to static electrical treatment, with or without strapping; whereas the latter require, first, fixation and the employment of judicious passive motion and adapted treatment occasionally, as with the static brush discharge, to avoid ankylosis, and subsequent physical treatment.

It was in the treatment of traumatic arthritis in the year 1900 that the *modus operandi* or effect of the method to be described was discovered by the writer. It was a novelty in medicine and surgery, and has been slow to obtain general professional recognition, as are all innovations; particularly so when a new method employs electricity. While it may be justly stated that no other method so promptly cures uncomplicated synovitis as the method to be described, few orthopædists are either aware of the method or its value.

The author's method of treating all non-infected inflammation concedes that the first indication is the removal of the swelling,—the condition of local stasis. In traumatic arthritis when not complicated by fracture the swelling and ever-present complicating muscular spasm arising from end-nerve irritation associated with the pressure and pain are the two conditions demanding relief. Under no other conditions than by the removal of the exudations can there be a prompt and complete restoration of local tissue metabolism and repair. This is the fundamental, basic principle to which the static current contributes as no other measure does to the cure of acute and chronic inflammation when no local infection is present; because no other measure will so effectively accomplish the tissue drainage.

The drainage or expulsion of the accumulated infiltration as present in swollen tissues by way of the lymph-channels is effected

by causing the engorged tissues successively to contract. This is accomplished without irritation by no other means known to science as by the mechanical effects peculiar to the static wave current, static brush discharge, and static sparks. Under proper administration of these measures a *visible* reduction of the swelling with *softening* of the parts takes place during the administration. It is the visible accomplishment of this result that demonstrates beyond question that tissue drainage is effected. This observation led to the writer's first publication on the treatment of local stasis.¹ It is this result effected without irritation and with such marked efficiency that renders the static machine indispensable for the prompt relief of acute and chronic inflammation in every accessible part of the human body, when the part is not the seat of fracture, infection, or malignancy.

Furthermore, for the relaxation of acute and subacute muscular spasm there is no known method so generally effective as the static current. It is from this point of view that the static modalities are employed in the treatment of traumatic arthritis and in conjunction with measures directed to the removal of local infection in toxic arthritis; *i.e.*, it is applied to joints affected by a toxic process for the relief of the local trouble, while the elsewhere local infection receives other treatment.

The author's method of applying the static current to an inflamed joint, which has been often described, is as follows: To employ the static wave current, a piece of soft metal, not foil, but thick enough to keep its form without becoming easily wrinkled, is moulded over the soft and swollen structures of a joint, as for the knee-joint on either side and around the patella. A spark-gap—the measure for dosage—with slowly-discharging sparks across the gap as long as can be used without causing too severe pain or muscular spasm is employed. The current is administered in this manner for twenty minutes, and then followed, in acute cases, as in ankle sprains, with a fairly long application of the static brush discharge. It was during the administration of this modality that a swelling was first observed to gradually diminish in size. This has been remarked frequently by patients and observers, and is always noticeable, and confirmed by actual measurement. Following the brush discharge, the static sparks should be applied with energy, and abundantly, to the deeper

¹ "Static Electricity and Uses of the X-ray," p. 72 (1903).

interspaces between the bones in order to expel exudation present in the structures of the joint not affected by the milder applications. Sparks should never be applied over bony prominences, because they cause needless pain and do no good except when applied over tissues which respond with contractions. Patients may be easily encouraged to take these painful administrations if asked frequently to test the movements of the affected joints during applications, because they will find that, following the applications, they can move the part with greater freedom and less pain. In most cases they will ask for more sparks here or there. Static sparks are no more painful than applications of the actual cautery, as commonly practised by orthopaedic surgeons, and are not followed by a discomfort comparable to the burned surfaces after cautery, and are a hundred-fold more effective. Following applications to inflamed joints, as in all conditions of local inflammation for which the static modalities are employed, after sparking about an affected joint, the body of each contracted muscle should be sparked sufficiently to effect relaxation of the muscular tension, thereby greatly facilitating the movements of the joint and, at the same time, permitting movement with less pain (Figs. 1 and 2).

By these applications the patient at once feels relieved not only from pain but from all stiffness and tension and even of heaviness, and moves with greater ease and freedom. This treatment may be administered daily with advantage until cured in most cases. Uncomplicated cases of acute synovitis or sprains are promptly relieved in a few days; it rarely taking more than three treatments to completely restore the ankle sprain to a normal condition when a thorough technic is employed. In rare cases, however, four or five daily treatments may be required. This is accomplished without strapping, the patient being allowed to go about without special restrictions as to the use of the joint. It is a common thing for a patient suffering from a severe sprain of the ankle to come in with assistance or on crutches and walk out with comparatively little pain, no longer requiring assistance or crutches.

Sacro-iliac luxation—what is known as Goldwaite's disease—furnishes one of the most striking examples of the value of electro-therapeutics, particularly of the static current. The relief of most, if not all, early cases may be effected in a few days by the systematic

FIG. 1.



The application of metal electrodes and their attachment to the static machine when administering the static wave current.

FIG. 2



The application of the metal electrodes to the knee-joint when treating a tuberculous joint
by the direct d'Arsonval method.

employment of the static wave current, manipulation, and exercise. In these cases muscular spasm following the luxation is marked in the glutei, psoas, and quadratus lumborum muscles, the control of which after reduction is the leading indication.

To produce and maintain relaxation of muscular spasm is essential, for, no matter how often a part is reduced, unless this is effected the luxation will recur. To effect such relaxation the static wave current is applied to the contracted muscles and the spark-gap gradually increased from six to ten inches, or as long as it can be tolerated by the patient without producing too great discomfort.

The writer has treated upwards of ten cases of sacro-iliac luxation in the acute stages, all of which have come under his observation supposedly to be treated for sciatica. In every case they have been promptly relieved and cured within three weeks. The following cases will best illustrate the method of managing the conditions:

Doctor McK. was brought to my office, a medical friend assisting him, suffering from a sacro-iliac luxation. His condition was so aggravated that it was impossible for him to raise the heel one inch from the table when lying upon his back. The disability was so marked that it was only with assistance that he could get from the carriage to the house. The static wave current was applied with a soft metal electrode six by ten inches over the glutei muscles, extending up over the lower end of the quadratus lumborum. The current borne at the beginning of the treatment was measured by a spark-gap of two inches. This was gradually increased to eight or ten inches in fifteen minutes, when there was no pain, indicating that the muscular spasm was completely relaxed.

Following this, the patient was placed prone upon the table, when, with one hand under the affected thigh and the other placed over the synchondrosis, pressure and manipulation were employed; the thigh was then lifted upward and backward. The patient was then instructed to follow a method of exercise suggested to the writer by Dr. Frank E. Peekham. He was instructed to raise the body in the opisthotonus position twice daily while lying upon his back and supporting his weight upon his heels and shoulders. This was done several times, morning and evening, in order to exercise the muscles in a manner that would tend to maintain or pull the bones into normal position. The relief from the first treatment was marked. He came on the three succeeding days, and the fifth treatment was given after an interval of one day. During this time after the first treatment he kept up his active professional work. After the fifth treatment he was entirely cured. Ten days after the last treatment he called me on the telephone and told me that it had been absolutely unnecessary for him to come for another treatment, as he was entirely well. This patient I exhibited at the meeting of the American Electro-Therapeutic Association in September as an example of the successful treatment of rheumatoid arthritis, he having been treated by us ten years previous to his sacro-iliac attack for that condition.

Another case was promptly cured in the person of a young iron worker. The luxation had been caused by the muscular exertion of lifting heavy iron girders which he was assisting to put in place in the construction of a modern iron frame building. This case was as promptly cured as the other, and ceased to require treatment after five days' application. I could enumerate other similar cases of early luxation that have been referred to me, in most instances by physicians for the treatment of sciatica. Results have been so gratifying that it is with great satisfaction I call attention to results which seem to be remarkable, judging from others' reports. Chronic cases are not so promptly responsive, often requiring the skill and facilities of an orthopaedic surgeon to first break up adhesions. Following this, however, there is no measure reported which will assist to cure these cases so promptly as the static current applied daily to maintain relaxation of the muscles, together with the employment of systematic exercises as employed by Dr. Peckham.

In some patients it is also necessary to relieve the painful condition in the sciatic or crural nerve, or both, and to relax the spasm of the adductor muscles, supplied by the lumbosacral cord by the application of the static wave current with a metal rectal electrode placed in the rectum against the nerves which become inflamed where they cross the synchondrosis. Stretching of the psoas muscle with the patient lying in the prone position, by the extension backward of the thigh in these cases, together with the exercises as described, assists in overcoming the spasm of this muscle, which is not easily accessible to the current. Where the adductors are very tense, as they are apt to be owing to irritation of the lumbosacral cord where it crosses the synchondrosis, the application of the static wave current with a flat metal electrode over the inner side of the thigh will relax the spasm of the muscles.

The history of one case of traumatic arthritis with synovitis which came under the observation of the writer in 1899, and which served as an early lesson, will explain the *modus operandi* and results of electrostatic treatment of an otherwise stubborn condition.

F. S., a manufacturer, came to the writer in March, 1899, suffering from the effects of an injury obtained when alighting from a moving trolley car. He felt a slight click in the right knee-joint when he alighted from the car; it caused him no inconvenience, however, during the day, but the night following

he was seized with a severe pain in the joint, which became swollen and painful, and was confined to the bed for three or four weeks under medical care. After a few weeks he was able to get about on crutches, and returned to his business. A short time later the condition again became much aggravated, and he was again confined to his house for two or three months, after which he came to me. He went about only on crutches, and was unable to bear any weight upon the affected limb. Just previous to coming under observation he had been advised by an orthopædic surgeon to obtain an iron brace to support his weight from the hip, and while having it adjusted at Tieman's factory, in answer to an inquiry, was told by the workman that he would be obliged to wear it always. To this he demurred, stating that he would never wear it.

When this patient came under observation the writer had never observed the treatment of a similar case, but used the method as above described on general principles. The motion of the joint was limited to an arc of about 45°, evidencing the fact that there was no ankylosis. It was very much swollen and very painful upon manipulation. In two weeks, under daily treatment with the wave current and an abundance of two- or three-inch indirect static sparks as above described, he was able to walk without pain and was able to go about in the public conveyances, whereas prior to this he had been compelled to go about in a cab. The improvement was progressive, and the treatment was persisted in faithfully for three months, when the condition was entirely cured. The joint was, to all appearances, the same as the other, with absolutely no pain of any sort, and there was no recurrence to the time of his death, nine years later.

These results have been duplicated in every similar case that has come under the writer's observation in which the lesion has not been present for more than two years. In cases of several months' duration there may be a certain amount of hyperplastic tissue developed that will persist around the joint. It is, however, gratifying to state that in traumatic cases, in which there is fluid and infiltration in the structures of the joint, the static sparks will remove them. It must be insisted, however, that these patients be treated daily and thoroughly, in order to obtain the most prompt results. Uniformly good results are obtained in all uncomplicated cases.

When luxations with rupture or fracture of the parts are present, during the time required for the repair, rest must be enjoined. The static brush discharge used frequently during this stage facilitates the repair and affords great relief to the patient when applied to the swollen parts. It is also imperative, under these conditions, that the part should be judiciously exercised, and often enough to insure against ankylosis. It is far better to prepare the plaster or other cast in such a way that it can be removed and replaced in order to permit the application of the brush discharge and the employment of exercise during the process of repair, thereby saving the joint from

the serious consequences of ankylosis. These observations are made owing to the fact that so many cases of ankylosis come under observation.

Gouty arthritis is generally conceded to arise from impaired function of the liver; whether from changed chemical conditions or from toxæmia may be ultimately determined. The liver function at least demands attention, as in the treatment of arthritis arising from intestinal infection. It is the writer's practice, now, in the treatment of gout and all cases in which toxæmia is conceded to be present, to employ the static wave current with a large flat metal electrode, approximately four by eight inches, over the liver, employing a spark-gap of from three to six inches, in order to bring about a prompt restoration of its function by removing from it the infiltration present, and at the same time accelerating the metabolism of the organ. That this can be so accomplished by the wave current must be conceded when it is easily demonstrated that a cirrhotic liver of more than three times the normal size can be reduced practically to normal in a few weeks by the same means. This has been done under the observation of, and by some of, my students, who can confirm this statement. In gouty arthritis this treatment of the liver is one of the methods for first consideration. In addition to this and the routine regulation of diet, the local treatment of the inflamed joint or joints with the static brush discharge and the direct d'Arsonval current (with the latter placing an electrode on either side and passing as large a milliampèrage of high-frequency current through the part as can be borne by the patient) will relax the tissue by heat and give prompt relief from the local pain. A few such applications, with careful adherence to diet, will place the patient in a condition not requiring frequent treatment.

Frauenthal has recommended a method of local treatment by ionic application of the salts of colchicum with the constant current to the joint. While this can give local relief, it does not insure the same degree of immunity as the correction of the liver condition by the static current, and the relief is not so complete as the local application of the static brush discharge and thermal penetration, and does not so promptly remove the swelling.

Infectious Arthritis.—This classification includes two types, one of local joint infection and the other of toxic arthritis arising from

a remote infection, which include conditions otherwise variously classified. The locally infected joints are largely of the tubercular type, rarely of pyogenic infection, and more rarely of pneumococcic infection. It is also claimed by observers that the germs are often present in gonorrhœal arthritis. This, however, is not the main source of the trouble, as is demonstrated by the prompt cure of the condition by treatment of the vesicles in the male. It undoubtedly ranks properly with the toxic cases.

The treatment of an infected joint demands the employment of a different routine treatment from those of traumatic and local toxic origin. The destruction of the germ *in situ* is the thing indicated. The striking results obtained by heliotherapy applied in institutions where children have been placed in the sunlight day after day successively in the open air have given most striking evidences of the relief of tubercular arthritis and progressive tubercular processes by the administration of radiant energy.

The employment of the Röntgen ray in these cases has also been followed by most striking instances of improvement. Cases have also been cured by the use of radiant light and heat and the d'Arsonval thermal penetration method. There is no reason, however, to expect much improvement when the joint has undergone structural change, or when ankylosis is present. If, however, these cases come under observation in the early stages, the prognosis may be said to be fairly good in average cases providing a careful routine treatment is followed. A series of X-ray exposures, or a massive X-ray dose, if one is willing to take the risk, may be administered, taking care to preclude the possibility of setting up a destructive dermatitis. In the writer's judgment, this is more safely accomplished by application of the customary frequent small doses to the extent of producing a commencing dermatitis, after which the employment of the X-ray should be finally discontinued and the institution of applications of radiant light and heat for periods of one-half hour to one hour daily, regulating the intensity to the limit of toleration from an incandescent or arc lamp, this to be followed each day by a half hour of thermal penetration, placing metal electrodes on opposite sides of the joint, and passing a direct d'Arsonval current through the joint of sufficient strength to produce as much heat as can be borne at the surface.

It is often difficult to diagnose a synovitis from a tubercular joint in the early stages by X-ray examination. The writer has demonstrated, however, that the application of the static wave current to any tubercular or otherwise infected joint increases the local irritation, as it naturally would. After two or three applications it will aggravate instead of improve the condition, and will fairly well indicate an infected joint, either of tubercular or other infection. The condition and history of the case will otherwise determine the diagnosis. This method of diagnosis may be questioned; the writer, however, feels justified in adopting the method, because the treatment of infection in all cases under these conditions may succeed in early cases, and there is no danger from a few administrations.

Pyogenic bacteria are, as a rule, promptly destroyed by this routine treatment, and tubercular processes in the early stages may be arrested and the joint restored. The writer has no experience with pneumococcic infection, but would employ the same routine on general principles.

Cases of toxic arthritis always demand treatment of the local joint affection and, at the same time, attention to the intestinal tract, or to whatever part the local infection may be traced, as a toxic cause of an arthritis.

Rheumatic arthritis, properly designated *infectious or toxic arthritis*, arises from some infection, probably in the alimentary tract, the cause of which has not been substantially determined. It may or may not be associated with other toxic conditions. In childhood high blood-pressure is an indication of active toxæmia, which may manifest itself as an arthritis, endocarditis, epilepsy, or other cardiac affection. Augmented blood-pressure is uniformly present in these cases, and suggests careful investigation of the alimentary conditions, or of other local infection that might be a source of the toxæmia.

The use of salicylates, which probably act as intestinal anti-septics, and the careful regulation of diet, systematically eliminating animal proteids, together with the institution of daily and normal evacuations or colonic flushings, are the matters for first consideration, and, secondary to these, the local treatment of the locally inflamed joint or joints. Static electrical treatment is of minor importance except in chronic cases in which the joint has been left

impaired by local swelling and conditions of muscular contraction, when the routine plan of treatment should be directed to treat both the inflamed joint and the contracted muscles, the same as in the treatment of traumatic arthritis as described.

Rheumatoid arthritis and Still's disease, characterized by uniform swelling bilaterally of many or all of the joints, and in the latter a characteristic enlargement of the spleen. Both conditions call for practically the same consideration in the matter of treatment, except that the wave current alone is required in Still's disease. Bannantine contended, many years since, and more recently others have claimed, that a particular germ is present locally in the joints, and that the swellings are not due to toxæmia. This is not borne out by clinical experiences, unless it can be shown that mechanical measures destroy them. A large percentage of cases when put under an absolutely meat-free diet and judicious use of high colonic flushings, with local treatment of the joints, as in the treatment of traumatic arthritis, are clinically cured if they come under observation before destructive involvement of the joint structures has taken place.

The writer has recorded upwards of twenty-five cases that have ceased to be troubled with this affection during the past fifteen years. In the first years these received only static electrical treatment; more recently, however, the same methods have been combined with a low proteid régime and colonic flushings. The application of static sparks to all affected joints gives more striking relief to these patients than any other method, but requires time and patience on the part of both physician and patient. Many of them may also be greatly benefited by the additional use of dry heat and light baths for their effects on general metabolism. The thermic treatment employed alone, however, has not produced striking results in these cases, whereas the static treatment used singly has given an excellent series of cures; better than reports from any other method previously described, and we have employed them all, singly and in combination.

In Still's disease striking results are obtained by the static current alone. We have had the opportunity to observe two cases of this disease, reports of which were published in the second edition of the writer's work on "Static Electricity and Uses of the X-ray."

The first of these cases was so far advanced and in such a pitiful condition when it came under observation that a cure was impossible,

but the prompt relief from pain following the application, over the joints, of the static wave current was one of the evidences that assured the writer of the great value of the electrostatic treatment in the early days of investigation. For the first ten days joints which it was absolutely impossible to manipulate for pain became relatively free from pain on manipulation, and remained so while the child was under observation for upwards of two years. He died finally from parenchymatous nephritis, from which he had also suffered during the course of the trouble.

The other case was referred to the writer by Dr. Royal Whitman, and, as in the previous case, the child by daily treatment was completely relieved from pain in the joints within two weeks, and after six weeks' treatment ceased to have any further trouble. The child has been exhibited three times before medical societies, once before the Orthopædic Section of the Academy of Medicine, and recently at the last meeting of the American Electro-Therapeutic Association. There has been no evidence of recurrences now twelve years since. She had been for more than a year under treatment at the Hospital for Ruptured and Cripples, steadily growing worse, before receiving treatment as described.

Other conditions of toxic arthritis arise from local infections, and are always stubborn and resistant to treatment unless the local cause is discovered and cured. Some cases may be due to pneumo-coccic infection, and others to pyogenic or gonorrhœal infection.

After Fuller described his method of treatment of gonorrhœal arthritis by curettage of the vesicles as successful, the writer was convinced that these cases could be promptly cured by local treatment with the static wave current and treatment with a rectal vacuum tube combined, and at once instituted that plan of treatment, which has proved uniformly successful, as it has also in epididymitis. Cases which had been absolutely resistant to local treatment of the joint by the wave current, sparks, and other measures were promptly cured by the application of the vacuum tube, employed with the same connection as the static wave current, for fifteen minutes, followed by a twenty-minute application of the static wave current with a metal electrode: the first for its combined antiseptic and mechanical effects, and the latter to mechanically empty the vesicles. The promptness with which these cases are cured is phenomenal. The

current itself seems to act upon the germs, causing their disorganization, and, at the same time, expels them through the normal channels of exit. The vacuum tube current acts also as an antiseptic.

Dr. Frank E. Peckham, of Providence, an orthopædic surgeon and a conservative observer, has made the following statement to the writer, in which we fully concur. He says that "if there is one thing that I can cure with static electricity, it is gonorrhœal arthritis." The results from this treatment have been denied by Fuller, but his opinion can be held as not having been based upon actual experience, but probably from the assumed opinion that static electricity is not effective in any condition, as he is on record as having stated.

Conclusion.—These observations are the result of fifteen years' experiences in the treatment of arthritis, and have been repeatedly verified by others. There is no field in therapeutics so ripe and rich for the employment of electrotherapeutics as the types of arthritis by the methods described, and there is no treatment so neglected, useful as it is, by the orthopædic surgeons as this method of treatment. It is to be deplored that so little attention is given by all leading orthopædist to the physical methods which offer so much relief of human suffering in conditions in which other methods repeatedly fail. Very much of success with the methods described depends upon the thoroughness of the technic and the regulation and frequency of treatment in these cases. The ultimate success, however, when the proper technic is regularly employed in the treatment of most cases of arthritis, is most gratifying.

That these methods are not understood or appreciated by those not familiar with the technic is no surprise; but if investigated in a broad-minded spirit the results will be confirmed and the effects produced by the current will be recognized. The electrotherapeutist is generally considered to be an incorrigible enthusiast, and it is the claims for such results that are not understood by those unfamiliar with the methods which lead to their being often dubbed as ultra-enthusiasts. Demonstrable methods, however, will stand the test of time, to be finally accepted and adopted.

THE PRESENT STATUS OF THE RÖNTGEN RAYS IN THE DIAGNOSIS AND TREATMENT OF DISEASE

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In the preparation of this brief *résumé* the editor has requested me to keep in mind the needs of the general practitioner. The immensity of this subject will prevent any more than plain, terse statements, giving as nearly as possible the truth as to the value of the Röntgen rays in diagnosis and treatment, so that the general practitioner can be quickly informed and can serve his patient best. Therefore, all reference to specific technic must be eliminated, and even qualifying remarks and illustrative cases must be much abridged or omitted. It is always well to assure the patient that there is no sensation and no harm to come from an examination when properly done.

RÖNTGEN DIAGNOSIS

Röntgen diagnosis to-day involves every portion of the body. We have gradually learned to eliminate errors by constantly increasing the work done upon each patient, and by the united efforts of röntgenologists throughout the world in their effort to develop the technic and interpretation of röntgenograms and röntgenoscopic images.

The röntgenoscope (fluoroscope) is useful, particularly, in the study of movable organs, and should be confined to the study of conditions within the chest and abdominal cavities. There is nothing to be gained by fluoroscopy of the head and extremities, and if depended upon alone much may be overlooked. It involves unnecessary exposure of both the patient and operator.

Röntgenograms, or X-ray plates, should be made in all cases, even though a röntgenoscopic examination has been made previously. Many more plates are used in an examination to-day than were used a few years ago. While this increases the expense to a considerable degree, it makes the results more accurate. Those röntgenologists who have done the most work appreciate most the difficulties of the subject, and especially the difficulty in accurate interpretation. The

tendency is to do more and more work on each case, so as to eliminate errors.

Fractures and Dislocations.—The presence or absence of a fracture can always be determined if sufficient skilful work is done. I believe the fluoroscope should never be depended upon for the diagnosis of fracture. It may sometimes be useful in setting fractures, but is a dangerous procedure, and involves unnecessary risks to both the operator and the patient. There should always be at least two röntgenograms made from more than one direction. When possible these should be made at right angles to each other, or stereoscopically. One must always use rays of sufficient penetrative quantity to pass through the bone, otherwise the absence of a fracture cannot be diagnosed. When there is doubt about the presence of a fracture, the examination should be made without dressings. When the attending surgeon is positive of the presence of a fracture, it is then advisable to reduce the fragments to the best possible position and examine through the dressings. In this way, not only the diagnosis and character of the fracture can be determined, but the position of the fragments in the dressing can be demonstrated. In such instances opaque dressings should be avoided, such as metallic splints (except they be aluminum); lead water and laudanum, mercurial ointments, and iodoform dressings should be avoided. Examinations can be made through wood, cotton, and plaster casts when they are dry. The thicker the dressing, the more obscure will be the röntgenogram.

Dislocations should generally be examined either before or after reduction, because there is a fracture often associated in dislocations, which, when present and not properly treated, often leads to stiff and painful joints.

Diseases of Bones and Joints.—At present it is nearly always possible to make a definite diagnosis as to the nature of the disease of bones or joints, its location and extent. Therefore by this examination there is at once placed in the hands of the attending physician the knowledge which will permit him to treat skilfully a bone or joint disease having a constitutional origin, such as lues, or other general infections. It gives to the surgeon not only the nature of the disease, but the extent also, and permits him to decide for or against surgical interference; for or against amputation or curetttement, and in every instance will help him to eliminate all the disease.

Disease of bone is indicated by some increase or decrease in the density, either local or general; by an increase or decrease in its size; or by some disturbance in the arrangement of the cancellous structure of the bone. Therefore, when skilfully done, any disease of bone should be demonstrable. For example, carcinoma of bone causes localized destruction of the lime salts, and later cavity formation. In tuberculosis there is more general absorption of lime salts, decreasing the general density, but usually there is less partially localized destruction. *Sarcoma* usually shows destruction of the normal bone and the new growth of bone. In the medullary type there is a spreading and thinning of the walls. In the periosteal type there is a lifting of the periosteum beyond the tumor. *Pyogenic infections*, such as abscess and osteomyelitis, show destructive areas, giving rise to increased transparency, associated with a sclerosis indicated by increased density. Therefore we have in this process beautifully demonstrated the destructive effect caused by the bacteria, associated with the resistance offered by the body, which is indicated by this sclerotic effect, this being Nature's effort to set up barriers against its invasion. The relative amounts of destruction and sclerosis will depend upon the extent to which Nature succeeds in confining the disease. Some of the diseases which can be clearly demonstrated are enchondromata, bone cysts, abscesses, chronic osteomyelitis, exostoses, sarcoma, carcinoma, syphilis, trophic lesions, and periostitis.

Diseases of the joints present changes similar to those described above, depending upon the nature of the disease, and these are also associated with some obscurity of the normally clear joint outlines and joint interspaces. The joint outlines may either be partially or wholly destroyed, as in tuberculosis, malignant disease, syphilis, or trophic disease; or may be roughened, as in osteo-arthritis, or may present bony deposits at the edges, as in osteo-arthritis. There is also commonly associated some infiltration of the surrounding soft tissues which increases their density.

Disease of the Chest.—Practically all diseases of the chest can be demonstrated. *Disease of the lungs* is indicated: First, by areas of increased density, such as occurs in tuberculosis, tumors, pneumonia, abscess formation, anthracosis, etc. Second, by increased general transparency, as in emphysema; or by increased local trans-

parenchy, such as occurs in local emphysema, bronchiectasis, cavity formation. Third, we may have an area of increased transparency surrounded by a border of increased density, such as occurs in abscesses, tubercular cavities, gangrene. Fourth, disease of the lungs may also be indicated by some impairment in the movement of the diaphragm, such as occurs in tuberculosis, pneumonia, abscess, gangrene, etc.

Disease of the pleural cavity is shown: First, by a rather uniform increase in density, having no definite outline, which generally indicates thickened pleura. Second, one may have this same general appearance associated with an upper level, such as is found in the standing posture, with pleural effusion. Third, the lungs and mediastinal organs may be displaced, such as occurs in large pleural effusions. Fourth, the lungs and mediastinal tissues may be displaced by a pneumothorax, which gives an area of marked increased transparency between the wall of the chest and the border of the lung. Fifth, if, with these latter conditions, we have associated a lower level of fluid, which can be seen splashing in movement, one has demonstrated hydro- or pyopneumothorax.

Disease of the heart is indicated: First, by some change in size, as in hypertrophy. Second, by a change in outline, as in valvular disease, dilatation, or pericardial effusion. Third, by some change in peristaltic movements, such as occurs in valvular disease, dilatation, etc.

Disease of the mediastinum is usually indicated by some tumor formation. Primary tumors of the mediastinum are usually sarcoma. Multiple tumor formation is found in Hodgkin's disease, sarcoma, and tubercular glands. Carcinoma of the œsophagus at times gives distinct tumor formation, but is always associated with œsophageal symptoms.

Aneurism of the arch of the aorta gives the appearance of tumor formation, but is differentiated by the expansile pulsation, by its peculiar shape, and by the fact that it occupies the region of the aorta. Syphilis of the aorta, or aortitis, can be demonstrated often by its increased width. Calcareous plates in the aorta can be shown, and are often associated with angina pectoris.

Disease of the Alimentary Canal.—The alimentary canal can be demonstrated if one renders it either opaque by means of subcar-

bonate of bismuth, or if one renders it transparent by dilatation with air. Generally, for examinations of the gastro-intestinal tract, the patient should have no food previously for at least six hours, and generally should have the bowels empty, though the technic in these examinations must be varied very much, according to the organ to be investigated or the probable character of the disease to be demonstrated. When intestinal stasis is to be studied it is often best not to disturb the patient's habits and allow all meals. Then, after a normal breakfast, simply add bismuth and water.

Diseases of the Æsophagus.—Diseases of the œsophagus which can be demonstrated by means of the Röntgen rays are œsophagospasm, or cardiospasm, which usually causes temporary, complete obstruction and perhaps considerable dilatation, but in which the outlines are smooth. This constriction and obstruction is followed by complete relaxation, and the sudden passage of food, as observed röntgenoscopically. *Diverticula* usually occur in the upper portion, are smooth in outline, become filled with the bismuth mixture, and then cause obstruction by compression. *Benign strictures* are usually due to cicatrices following ulcers, or following the destruction caused by caustics which have been swallowed. They are associated with a dilatation above them, which gradually tapers to the point of the constriction. This tapering is generally smooth in outline, while *carcinoma of the œsophagus* is associated with irregularities, the constriction is rarely complete, and has, both within its lumen and in the dilatation above, a roughened or serrated outline.

The Stomach.—The stomach is generally outlined by bismuth mixture for study. *Carcinoma* generally invades the lumen of the stomach; most commonly occurs along the lesser curvature, and more often at the pyloric end. It is associated with marked irregularity, serrated edges, generally retention of food, and, when it involves the pyloric end, may cause marked obstruction, though I believe that dilatation of the stomach is generally due to a stenosis produced by the cicatrix of an old ulcer, and when carcinoma is associated it is probably a late degeneration of this cicatrix.

Ulcer of the stomach is indicated: First, by spasmodic contractions. Second, by retention of food beyond six hours. Third, by a localized tender point, usually within the stomach shadow. Fourth, by a projecting collection of bismuth outside of the general stomach

outline, such as occurs with perforation. Fifth, gastrectasis, such as follows the cicatrix produced by old ulcers of the pylorus.

Gastric carcinoma, I believe, can always be demonstrated as early as it will produce symptoms. *Gastric ulcer* can generally be demonstrated. *Duodenal ulcer* can be demonstrated in most instances by some variation in the outline of the duodenum, a retention of food in the stomach beyond six hours, or, when there is no constriction, by hypermotility. The combination of hyperperistalsis with retention of food for more than six hours, with a normal stomach outline, indicates old duodenal ulcer, usually with adhesions and constriction.

The Bowel.—Preparation of the Patient: If one is studying the functions of the bowel, no purgative is necessary unless the patient is constipated. One and a half ounces of bismuth subcarbonate may be given with a normal meal at the table, either with a glass of milk or buttermilk, or in a dish of oatmeal, but should be thoroughly mixed and taken at different times during the meal.

Generally it is best to begin with the patient's stomach and bowels thoroughly empty, and commonly I begin with a colonic injection consisting of two or more ounces of barium sulphate in sufficient kaolin to suspend it, and two or more pints of water. (Barium sulphite is very poisonous, and must be carefully avoided.) *Constrictions and dilatations of the small bowel* can be demonstrated, but must be interpreted with great care.

In the study of the *large bowel*, one should not only follow a bismuth meal through the alimentary canal, but there should also be given an opaque enema, such as barium sulphate, in a mixture of water and kaolin. By these means constrictions can be demonstrated, as well as the location and character. If the constriction is due to carcinoma it is generally irregular in outline, rather broad in extent, and often associated with a mass. A *benign constriction* may be due to adhesions, kinking, or twisting, each of which can be demonstrated and interpreted if one keeps in mind the general characteristics.

THE GALL-BLADDER AND GALL-BLADDER REGION

The gall-bladder and gall-bladder region probably offer more difficulties in diagnosis in general medicine than any other parts of the body. Even by means of the Röntgen rays it has been possible only

during the past few years to obtain any knowledge that is of definite value. The evidence of disease in this region, as demonstrated by the Röntgen rays, is becoming more and more definite, and at present a Röntgen study is of decided advantage in nearly all cases. *Gall-stones* can be demonstrated in at least fifty per cent. of cases, and, with the best technic, probably a higher percentage. My records up to the present time show an accuracy of seventy-four per cent.

Preparation of the Patient.—For this examination the patient should always be given a purgative on the night preceding, and report for examination before eating anything on the following day. All clothing should be eliminated from this part of the body.

The first step in a study of this region is an examination of the right kidney. Second, the gall-bladder region should then be examined directly from various directions and by varying exposures, all of which should be done while the patient is holding the breath absolutely still. The greatest difficulties will be encountered in stout, muscular patients and those who have nearly pure cholesterolin stones. Those most easily demonstrated will be in patients who are thin or emaciated, and who have gall-stones containing a large percentage of lime. Between these two extreme conditions one will find the great majority, and therefore the percentage of stones which can be demonstrated will vary with the above conditions and with the skill of the röntgenologist. The shadows produced by gall-stones must always be eliminated from those of kidney stone, calcified glands, calcified costal cartilages, foreign bodies such as pills or particles of bismuth that may be in the bowel, etc. Third: The third step in this study is an examination of the stomach and duodenum, and ascertaining the relation of the duodenum to the gall-bladder region. In connection with gall-bladder disease one commonly finds adhesions of the duodenum in this region. These are indicated by a retraction of the pylorus and duodenum toward the liver, and these move upward exactly as much as the liver. In other instances there are associated constrictions of the duodenum, due to adhesions, or the duodenum may follow the entire under border of the liver and be carried out to the right lateral wall of the abdomen. These adhesions should always be searched for, because at times they will produce the same symptoms as gall-stones. There is a great chance for error in making a diagnosis of adhesions, and especially is this true in very stout patients in

whom the stomach is crowded upward and to the right by the pressure of the intra-abdominal fat. There are other conditions also which will displace the stomach, such as tumors, gas in the bowel, etc.

GENITO-URINARY SYSTEM

Preparation of the Patient.—For all examinations of the kidneys, ureters, or bladder the patient should be previously well purged, for this at once removes many of the solid substances within the bowel, which might be mistaken for urinary calculus. Such intestinal bodies are sugar-coated pills, or compressed tablets, bits of bismuth, fecal concretions, etc. Generally it is not necessary for the patients to deprive themselves of their meal. There should be no clothing about the abdomen during an examination, excepting a sheet, which can be used to prevent exposure. The examination should always be complete—both kidneys, both ureters, and bladder should be studied, for not infrequently the pains of renal colic are produced by, or associated with, calculus on the opposite side. More frequently calculi are present on both sides, and at times the conditions are more serious on the side opposite to the seat of pain. By the most modern technic the abdomen is examined in sections, which requires a number of exposures and a like number of plates. Generally it is advisable to use a certain amount of compression of the abdomen in these examinations. This assists in holding the abdominal contents still, and displaces gas in some of the soft tissues so as to give more satisfactory results. By this technic ninety-eight per cent. of urinary calculi can be demonstrated. Generally the outline of the kidneys can be shown, which will give us both the size and shape. Therefore at times the evidence of a hydro- or pyonephrosis, or tumor of the kidney, can be demonstrated. At times ureteral calculi must be differentiated from calcified glands, phleboliths, or other extra-ureteral concretions. This can be accomplished either by the passage of a lead ureteral sound or by the injection of opaque solutions into the ureter and pelvis of the kidney. This requires the services of a cystoscopist. By the same process the pelvis of the kidney can be outlined, a hydro- or pyonephrosis more clearly demonstrated, or tubercular ulceration in the kidney definitely outlined. When the symptoms refer especially to the bladder it is generally wise to make a röntgenogram both anteriorly and posteriorly. Then, if tumor is under consideration,

the bladder may be injected with air and these plates repeated. If tumor or diverticula are under consideration, the bladder may then be injected with opaque solution, such as cargentos, or a mixture of bismuth and kaolin.

THE HEAD

The Cranium and Cranial Cavity.—The diseases affecting the cranium which can be demonstrated by means of the Röntgen rays are those which cause some disturbance either in the density, thickness, or cancellous structure of the bone. First among these will be *fractures*.

At times a fracture of the cranium can be easily demonstrated, but generally a number of röntgenograms must be made by exposures from various directions, so that at some time during the exposure the rays will be passing through the fissure. Generally there is little or no displacement. Therefore a demonstration of the fracture fissure is all that we can expect. Diseases which cause thickening of bone are exostoses, the sclerosis following an old inflammatory process, and at times thickening of the dura, and rarely tumor formation.

Diseases which cause a disturbance in the cancellous structure are shown by a disruption of the cancellous lines, such as occurs in syphilis, or osteomyelitis, which produces a worm-eaten appearance; or tuberculosis, which produces a trophic absorptive appearance; or absorption of bone produced by pressure, such as tumor growing from the brain.

The diseases affecting the cranial cavity which can be demonstrated by the Röntgen rays are tumors or their effects. Tumors of the brain, such as glioma or fibrosarcoma, can only at times be demonstrated. They can be demonstrated when they contain considerable fibrous tissue, or when they are associated with deposits of lime, or when they are superficial and perhaps associated with a pressure effect upon the cranial cavity. *Tumors of the hypophysis* or pituitary gland are demonstrable chiefly because they produce some change in the shape or size of the sella turcica, or when they have caused some absorption or displacement of the clinoid process. In most instances there will be an increase in the size of the sella turcica, absorption of one or more of the clinoid processes; perhaps a calcareous deposit in or about the tumor; and at times a pressure or absorptive effect

upon the base of the sella turcica. *The suprahypophyseal tumors* can be demonstrated only when they contain a considerable amount of fibrous tissue or calcareous deposit. The effects of the pituitary gland, or rather hypo- and hyperpituitarism, upon the general system, general growth, and general condition of the body have created a large field of usefulness for this method of diagnosis, and will at times indicate definitely the line of treatment that should be used. If the patient is suffering from hyperpituitarism, associated with tumor formation, we have the consideration of an operation or of Röntgen treatment which will gradually cause a diminution, and perhaps some atrophy, thereby decreasing pressure effects. If, on the other hand, the patient is suffering from hypopituitarism, and one finds the sella turcica abnormally small, we have clearly an indication for the administration of extracts of these glands. If operation is decided upon, the surgeon has a distinct advantage in knowing the size of the tumor or the condition of the sella turcica and the clinoid processes.

The accessory sinuses are even more important. The accessory sinuses are very frequently affected in a large proportion of the human race, especially those living in changeable climates. Therefore any assistance that will enable the physician or surgeon to make an accurate diagnosis of these sinus conditions will help him to find the cause of any headache, or any dull intellect, or dripping of secretions in the pharynx that patients complain of, and to explain the cause of neuralgia, ocular symptoms, discharge from unusual sinuses; and, by giving the surgeon definite information, he can operate on the region affected without unnecessary destruction of unaffected cells. The affections of the sinuses are mostly pyogenic in nature, or are due to tumor formation, and are recognized because the air-spaces are filled with exudate which causes a general opacity of the affected region as compared with the healthy side. Pus in the *maxillary sinuses* is very commonly secondary to some infection from the teeth, therefore a careful study of the teeth should be undertaken in any disease of the maxillary sinuses.

Röntgen Diagnosis of Conditions about the Teeth.—Practically any disease or abnormality about the teeth, alveolar process, or jaws can be demonstrated by means of the Röntgen rays. This is accomplished by both plates externally, and films inside the mouth. One must not expect to get all information by simply making a röntgeno-

gram of the whole face at once. In examining teeth and conditions about the jaw only small sections can be studied at any one time, because of the curves of the jaw and because of the overlapping shadows of the superimposed structures. A long list of conditions about the teeth which can be clearly recognized would be out of place in this brief *résumé*, but among those which concern the general practitioner are impacted teeth, abscesses and deformities of the jaw, which often give rise to neuralgias. Abscesses about the roots of the teeth give rise, very commonly, to many local and general symptoms. They may be the cause of obscure headaches, obscure ocular symptoms, obscure nervous disorders affecting the head, extremities, or viscera.

The Mastoid Cells.—Disease of the mastoids is demonstrable by means of the Röntgen rays when the cells become filled with exudate, or when there is some destruction of the septa. By a careful comparison of the two sides in many cases previous to operation the surgeon and röntgenologist together are enabled to decide whether operation is advisable, and, if advisable, at what point to operate so as to reach the central area of the disease. One also learns by such careful examination the relative location of the area of disease of the mastoid cells to the lateral sinuses, and in this way the surgeon is prepared for the emergency of hemorrhage from the sinuses, or is enabled by definite localization to avoid opening them.

RÖNTGEN THERAPY

The Röntgen rays have been used in the treatment of various diseases during the past fifteen years. During this time most chronic affections have been subjected to their influence. During the early years most of this form of treatment was done in a haphazard way and indifferent results obtained. In some instances the results were brilliant and almost startling, while in other instances absolute failures were obtained. This was due to the fact that for the most part treatment was given by those who failed to realize the principles underlying the effects of the rays, or a failure to use the proper technie and apply the proper dosage at the proper time. Knowledge was lacking, and practitioners who were generally well informed on medicine and surgery, but lacked this special knowledge, were carried away by the enthusiasm which led to the use of the rays as a last resort in cases in which there could be no reasonable hope for success.

This early wave of enthusiasm was therefore followed by one of deep disappointment, and by many Röntgen therapists was discarded as useless or harmful. During the past few years another wave of enthusiasm has developed, which is really justified by the brilliancy of results obtained, and unquestionably this same enthusiasm will lead a lot of untrained, unskilled, and perhaps careless men in the use of an agent which is now many times more powerful in effect, and therefore capable of doing much more harm, than was possible ten years ago, and I fear that we shall again undergo another period of depression and disappointment. To-day there is at hand much technical knowledge and much recorded experience which will be useful to any one who will take the trouble to learn it, but to master this technic and to become acquainted with the experiences of others, while enriching one's own experience, will require all the time that any one physician can find.

The röntgenologist is in a peculiar position. To be most useful he requires a large knowledge of clinical medicine; a fair degree of information upon gross pathology as it affects general medicine, general surgery, and each of the specialties. He should also have mastered the principles governing electricity and electrical apparatus, together with the physics of Röntgen rays. He should have mastered the principles governing photography, and with this must familiarize himself with the special knowledge of röntgenology. He then requires an extensive equipment which requires much space. Therefore röntgenology is more clearly a specialty than any other field of medicine. This does not mean that some work cannot be successfully done under other conditions, but those who attempt the work under other conditions must realize their handicap and be correspondingly cautious.

GENERAL BIOLOGICAL EFFECTS OF THE RÖNTGEN RAYS

In general the effects produced depend upon the absorption and chemical effects of the rays upon the cells of the tissues exposed. The total effect will depend upon the degree of sensitiveness of the particular cells and upon the quantity of absorption. The glandular epithelial cells of the body are the most sensitive, then the protective epithelium of the skin and mucous membrane, followed by the connective tissue, muscle, and nervous tissue.

Of the glands, the most sensitive are the testicles and ovaries, then the spleen, thymus and thyroid glands, the lymphatics and liver. Therefore these organs, when not under direct treatment, must be carefully protected.

The effects produced by the rays must of necessity involve only the tissues through which they pass, since they move in straight lines from their point of origin. Any other symptoms or manifestations in remote parts must be secondary to changes in the tissues directly irradiated, or are due to secondary rays generated in the tissues, or to substances generated or liberated under the influence of the rays.

The quantity of rays absorbed will depend upon the quantity striking the tissues, their duration, their quality, and the density of the tissue through which they pass. The quantity of X-rays striking the skin will depend upon the amount of milliamperage of current going through the tubes, the character of the target in the tube, the thickness of the glass, the character of the ions which are used in the production of the rays, the distance of the tube from the patient, and the duration of the treatment. Therefore, when one speaks only of the duration of the treatment, it means absolutely nothing as regards the dosage. It means no more than to say that gas escaped from a tank for ten minutes, for to know the quantity and effect of the escape of that gas one should know the size of the opening, the degree of pressure, the opportunity for diffusion on the outside, etc. The quantity of rays can be fairly and definitely measured by means of the barium platin-cyanide discs of Sabouraud and Noire, which change color under the influence of the rays, and according to the degree of this color the quantity of rays is fairly well measured. These gradations of color are fairly well measured by comparison with the scale arranged by Holzknecht in his radiometer, or by the Hampson scale. The Kienbock quantimeter is equally useful. It depends upon the use of a specially sensitized and standardized photographic paper, which is applied to the surface of the skin, and exposed while the patient is being treated, then developed under very definite conditions, and in the end the shade, or photographic effect, is compared with a different scale, ten degrees of which correspond to the dose required to produce a slight redness of the skin—or, in other words, an erythema dose. There-

fore this dose is often referred to as ten Kienbock units—or, in other words, the Kienbock unit corresponds to one-tenth of an erythema dose.

Soft rays are those which are least penetrating. Hard rays refer to those which are most penetrating. The degree of penetration can be measured by means of the penetrometer, either by the scale designed by Benoist or the one designed by Wehnelt.

Soft rays are more readily absorbed than the more penetrating or hard rays, and, especially in dealing with soft rays, the greater amount are absorbed in the skin and first centimetre of tissue. Therefore the first effect will be produced upon the skin, and the skin must be our index of the maximum dose permissible in a patient.

RÖNTGEN RAY BURNS

During the early years of röntgenology a series of Röntgen burns were produced, due to the lack of knowledge in their use. Succeeding this there was a period during which the use of the rays was confined to a comparatively few physicians who made this their specialty, and who mastered the principles and technic governing their use. As a consequence of this specialization and care there is a general impression among the profession that the danger of Röntgen burns has been entirely eliminated. This is a false position, for the danger of Röntgen burns is many times greater to-day than it was during the early years, for the reason that we use apparatus many times more powerful, and therefore capable of doing correspondingly more good or harm. Our safety lies in the knowledge of this danger, the skill in the use of the apparatus, and in observing the well-known means of protection to both the patient and operator. When the proper protection is used there is absolutely no danger to the patient, and probably no danger to the operator. The principles governing the protection of the patient and operator consist in: First, enclosing the tube in an opaque chamber, either glass, opaque rubber, or lead. Second, in permitting the rays only to emit from this protection chamber or casing through an opening which is no larger than is necessary for the particular work required. Third, the patient can be further protected by confining the rays especially to the area to be treated or examined, and this can be done by means of sheets of lead foil. Fourth, the patient is further protected by means of

filters which cover this opening through which the rays are passing. The filters most commonly used are of leather, first described by myself nine years ago; or one may use aluminum, from one to three millimetres in thickness, depending upon the depth of the disease to be treated. Fifth, the operator can protect himself by working behind lead-lined walls or within a lead cabinet, and by wearing opaque gloves, aprons, etc. Both the patient and the operator will also be further protected by limiting the use of the rays to the shortest period of time which is consistent with the results to be obtained.

The danger of X-ray burns is increased: First, by neglecting all the rules above laid down. Second, by the application of any local irritant to the skin, such as liniment, stimulating ointments, local heat, the application of high-frequency current, or any others which will bring about local congestion.

The first noticeable effect upon the normal skin is the production of an erythema, which is often spoken of as a "reaction." This is also recognized as the first degree of a burn, and is the maximum or "full" dose as measured by the above scales. Even this state is variable in degree, and at first appears as a slight blush, which increases until it becomes a deep red. This dose should seldom, if ever, be exceeded. If the full dose is given at one sitting, the redness will usually begin within a week and attain its maximum in the second week. This period of latency will vary somewhat with the softness of the rays and with the sensibility of the patient's skin. Blondes are more sensitive than brunettes. In the latter the delay may be more than two weeks, and, if the dose has been divided, a tanning usually occurs, which seems to make the skin more resistant and permits of a greater dosage.

The redness is accompanied by slight itching and a slight burning sensation. These symptoms will be relieved by the application of a simple ointment, such as cold cream, and afterward covered by talcum powder. The redness usually disappears within a week, and is followed by a slight desquamation within the following week. As a rule, it is best to interrupt the treatment for two weeks following such a reaction. Accompanying this reaction the hair usually falls out.

The falling out of hair need give no special alarm, for when

removed by a single maximum dose it invariably returns, and the return growth is heavier than the primary one. This return growth occurs in two to three months.

The second degree of burn, or Röntgen dermatitis, will occur at times as a result of one's anxiety to control a malignant growth which threatens the life of the patient, and the full dose is exceeded. This comes on in two to three weeks after the total dose has been given, or, if given in divided doses, may occur during the course of treatment. It consists of the appearances of the first degree, followed by the formation of vesicles, blebs, loss of skin, then crust formation, followed by healing, which requires several weeks. The result is the formation of a pink scar, and later this is likely to be infiltrated by telangiectasis, especially if further treatment has been given on the same area.

The treatment of this second degree of burn consists, in the early stage, in the applications of normal salt solution, or one per cent. picric acid solution. After the secretion ceases to be excessive, cold cream, covered by a soft cloth, will usually give relief and hasten healing. When crusts form, they must be removed from time to time by the application of a thick layer of cold cream on a cloth.

The third degree of X-ray burn should never occur. It occurred early in the history of X-ray work as a result of prolonged exposures for diagnostic purposes, and in the hands of incompetent operators. It, of course, may occur as a result of excessive exposure for any purpose. It passes quickly through the two preceding stages, and then forms a deep yellowish-gray ulcer. This either heals very slowly or may never heal. It also becomes extremely painful.

The treatment consists primarily of the treatment of the second degree until the ulcer limits itself and becomes stationary. The ulcerated area should then be excised without further delay, and followed by skin-grafting or transplantation.

Chronic radiodermatitis occurs in operators who have been exposed to the Röntgen rays or radio-active substances extending over a prolonged period of time. It consists of a premature senility of the skin, and corresponds almost exactly to the atrophy, fissures, and multiple keratoses which are seen in certain old people, especially in those whose skin has been exposed to some chronic irritation, such as the sun's rays or chemical irritants.

The treatment of this distressing condition consists primarily in prevention, by avoiding the exposure of the rays. In the early stages of this affection the skin must be protected from any further exposure, and it must also be protected from exposure to irritations of any other kind, such as developers, fixing baths, disinfectants, the sun's rays, and exposure to heat and cold. The skin lacks moisture and lubrication, due to an atrophy of the glands. I have found that the wearing of ordinary kid gloves almost continuously protects the skin from dirt, traumatism, cold, heat, and sun's rays, and serves to retain the moisture.

If the keratoses and fissures show no tendency to disappear under this protection, or if they increase and become painful or inflamed, they should at once be excised and the areas covered by healthy skin. Otherwise the degeneration goes on to malignancy, followed by metastases, which have caused the death of at least a dozen röntgenologists, and have resulted in the loss of the limbs of a number of others. A more recent, and apparently a more satisfactory, method of treating the keratoses and warts is by means of electrothermic desiccation.

The biological effects upon diseased tissue are of the same general character. The effects are, for the most part, of an atrophic nature, and, therefore, Röntgen therapy, or radiotherapy, is indicated in the conditions which are characterized by hypertrophy or hyperplasia, hypersecretion, or new-growths. The diseased tissue or diseased cells respond more readily to the effects of the rays than normal tissue, and, therefore, one commonly sees diseased tissue react to the rays and return to a normal condition without noticeable effect upon the surrounding or overlying tissue, which has been exposed equally as much or even more.

While the general and final effect is atrophic in nature, especially after prolonged treatment, if a single full dose is given, the reaction which is brought about may have a stimulating effect. This is illustrated by the increase in growth of hair following a temporary removal, resulting from a single full dose of rays. It is also illustrated by the growth of hair following Röntgen treatment of alopecia areata.

However, in contradiction to some authors, as a result of a wide

experience in the treatment of malignant disease, I have never seen any stimulation of a new-growth by the rays. This may be due to the fact that in the treatment of such conditions it is my custom to give full doses.

The relief of pain by the rays is an effect which has been observed by most or all operators, but which has not been satisfactorily explained. It does not always occur even in what would appear to be identical conditions. The pains of malignant disease are at times relieved, as well as those of chronic neuralgias, when the only alternative is stuporous doses of morphine.

DISEASES OF THE SKIN

Hypertrichosis.—The overgrowth of hair on women's faces is a tempting field for the use of the rays as an epilating agent, but usually the treatment must be carried to the extent of damaging the skin in order to make the effect permanent. This makes the skin look old and atrophied. On account of this danger I do not recommend it for general use in this affection. In exceptional cases, when the growth of hair is extensive, it is probably justifiable, and when most carefully done the results, I believe, are better than can be obtained in any other way.

Ringworm.—In hypertrichosis we are not dealing with disease, and the treatment is only demanded for aesthetic reasons. In the treatment of ringworm, however, we are dealing with a troublesome disease of the hair-follicles. The usual treatment is by the application of some form of antiseptic. Sabouraud wrote previously to the Röntgen treatment: "Not only is there no known cure for *tinea tonsurans*, but I think I am justified in saying there never will be a cure for this disease by the use of antiseptics. We may vary at will the chemical nature of the application we employ, but this will in no way alter their power of penetration. The root of the hair is inaccessible to external antiseptics." These same remarks regarding *tinea* will apply to *favus*. The parasites in these diseases affect and depend upon the vitality of the hair-follicles. Therefore, if we destroy temporarily the vitality of the hair-follicles, we eliminate the disease. The Röntgen rays are the ideal means for this purpose. The treatment is painless, and when carefully done is both harmless and permanent. For this purpose the scalp is divided into five areas,

and the application is so made that a full dose is given evenly over each of these five areas, the full dose being measured by the Sabouraud pastilles. Following this there will be a complete, or almost complete, alopecia within two to four weeks. After this the scalp should be kept carefully cleansed, and there is no objection to the mild use of antiseptics. Generally no second application of the rays is necessary. In about three months the hair returns, and generally this is a heavy growth of healthy hair.

Favus.—Practically all that is said above applies to favus, and need not be repeated. It is advisable in this disease to treat the entire scalp and then keep it covered with a mild antiseptic solution, such as diluted tincture of iodine or carbolic acid in lanolin.

Sycosis and Folliculitis of the Beard.—In these conditions one may usually expect a cure. The bare parts of the face and the mucous membrane should be covered with lead. The normal dose of from six to ten Kienbock units, or a full Sabouraud dose, should be given. After a latent period of about a week, epilation commences, the inflammatory symptoms increase, and the small abscesses around the hairs are evacuated, and after a time the skin heals completely. At times, in this disease, the skin is especially sensitive, and becomes much inflamed before epilation is complete.

Alopecia.—In quite a number of these cases of alopecia there has been a return of a good growth of hair, especially in alopecia areata. That the return growth of hair was due to the rays was shown by the new growth being confined to the areas treated by the rays, while no change was seen in the parts not so treated. The treatment is usually followed by a complete alopecia and then by the new hair. Success cannot be expected in those cases in which there are no lanugo hairs, nor in those cases in which there is a universal alopecia, with loss of eyebrows and eyelashes.

Acne Vulgaris and Acne Rosacea.—In the treatment of these conditions the rays are one of the accepted agents, and in the more chronic cases which have lasted over six months, and which have resisted the more simple methods, this form of treatment is probably second to none. In the early cases other methods should be given a trial.

The treatment should be confined to the affected areas. It should not be carried beyond the hyperæmic stage in its effects. Generally

less than a full dose should be given in these cases. The whole face should not be treated at once, but the areas affected should be treated in sections so as to get an even distribution of the rays, and treatment should not be repeated inside of two weeks. It usually requires from three to four months for a patient to get well. The final results are usually very gratifying, leaving the face smooth and soft. If much treatment has been required, the skin may lose some of its velvety appearance, but even this is preferable to a continuation of the disease. At first the scars from the old lesions (which were present before this treatment) become more practicable, because of a hyperæmia, but later they fade considerably as a result of the treatment. Patients will sometimes refer to these scars after the treatment has ceased. This is due to the fact that they had not noticed the scars which were present before treatment, because they were overshadowed by the surrounding acne lesions.

Psoriasis will usually yield to other external applications, together with internal medication, but in obstinate cases radiotherapy may be used with success. However, even with this treatment the results are not always permanent. The general technic described for the skin diseases may be used. The treatment should be carried only to the extent of producing a hyperæmia. This is followed by desquamation and disappearance of the disease in the area treated. A full dose can be given at one sitting.

Seborrhæic eczema will yield in the same way, with the same dose and same general technic.

Pruritus.—This condition usually affects the vulvar and anal regions. In all cases one should, of course, first search for a probable cause, and when this is found it must be removed. In the idiopathic cases, or when no cause can be determined, radiotherapy usually gives satisfactory results. The itching is relieved, and the thickened, indurated, eczematous skin is restored to normal. In this disease the rays should be especially confined to the affected area. In men the scrotum must be carefully protected by sheets of lead, on account of the effects on the testicles. If the scrotum is involved, it becomes a doubtful method of treatment. In this disease the treatment is given in fractional doses of about two Kienbock units each, and repeated from one to three times a week.

Prurigo, Lichen Ruber Planus, and Lichen Corneus.—Like most

of the skin diseases, radiotherapy may be recommended after the more common methods of treatment have failed to produce satisfactory results. The itching is one of the first symptoms to be relieved. This is followed by a reactive hyperæmic desquamation and a return of the skin to normal.

Lupus Vulgaris.—This is a disease that requires much patience, no matter what method of treatment we may choose. However, I have succeeded in curing patients in whom the disease has resisted other forms of treatment for from ten to fifteen years. Success may be expected, if the treatment is carefully and persistently given, in nearly all cases. In those cases in which large areas are involved, or in which most of the skin is diseased, and in which there is a coalescent, brawny, reddish-brown surface, success can hardly be expected. When the mucous membrane is involved the outlook is less hopeful than otherwise, though I have had success even in these cases.

Most authors recommend this treatment very highly, and place it scarcely second to the Finsen treatment. It is especially preferable in those cases in which the diseased tissues cannot be satisfactorily compressed for the Finsen treatment.

The treatment is usually given in fractional doses, and must be continued over months. Hyperæmia must be produced repeatedly, but not continuously. It is seldom necessary to give a dose that will produce more than a hyperæmia, and this effect should then be allowed to disappear before renewing the treatment.

Lupus Erythematosus.—A number of cures have been reported in this disease from Röntgen therapy, but it is considered generally less useful than in lupus vulgaris. Heavy doses are required. If a cure is obtained it is only as a result of a violent reaction and consecutive cutaneous atrophy.

Scleroderma, being another obstinate disease, has been subjected, in a number of cases, to radiotherapy. The results are not brilliant, and require much time and patience, but in the end are perhaps as satisfactory as other methods. The patches are comparatively insensitive to the rays, and a full dose must be repeated every three weeks.

Keloid offers a much more favorable prognosis, and the treatment can be highly recommended. Successes are obtained in patients who

have been operated upon repeatedly, and who have had other methods tried without success.

Mycosis fungoides is a formidable disease, and previous to the days of radiotherapy it was looked upon as almost hopeless. Therefore the good results obtained by means of the Röntgen rays become all the more important. Much patience and many treatments are necessary, but by persistence and care the disease can usually be made to disappear. The immediate result to be expected is a disappearance of the pruritus within two or three days following the above dose. Within six or seven days the skin over the tumors becomes slightly erythematous, and gradually takes on a brownish tint. The tumors gradually become softer, and after a fortnight they are diminished in size. After a few repetitions of this dose (on each tumor or affected area), at intervals of two or three weeks, they should entirely disappear. At each repetition of the dose it should be somewhat diminished.

Warts.—These have been treated by so many different methods that one is not limited to Röntgen therapy, but it is generally almost certain in its results, and the cosmetic effect is perfect. I have succeeded in eliminating warts that have occurred after being excised and cauterized, and these results have remained permanent after a number of years.

Nævus.—Radiotherapy has been used in the treatment of nævus with only a moderate degree of success, and generally cannot be recommended. The destruction of the nævus by means of the high-frequency current is by far superior.

Epitheliomata.—A natural step from the consideration of warts, moles, and keloidal formation is the study of the epitheliomata. In this disease, above all others, I believe the X-rays hold first place. This treatment offers the following advantages:

(1) It is painless in its application, and, therefore, patients can be more easily persuaded to be treated early. This in itself would be sufficient advantage to recommend it most highly, for it is the delays that make the prognosis so bad from any form of treatment.

(2) The treatment does not open lymph-channels and make fresh wounds through which the disease may spread.

(3) If treated early, and before the deep tissues are invaded, the

disease disappears, often without leaving any scar. When a scar does form it approaches most nearly in appearance that of normal skin. It is soft, pliable, and of a pinkish color. If this disease can be made to disappear without scar formation it accomplishes at once what no other method of treatment can hope for. If one avoids scar formation, the tendency to recurrence is correspondingly lessened, because there is more tendency for epitheliomatous formations in scar tissue than in healthy tissue.

(4) If the cases are treated early and skilfully, one may hope for recovery in at least 98 per cent. I believe no other method of treatment can claim nearly so much.

(5) Epitheliomata commonly affect areas such as those about the inner canthus of the eye, where there is little tissue to be spared without producing marked deformity and much annoyance. The destructive methods of treatment in these regions, even if successful, produce scars which contract and cause ectropion, with the train of eye symptoms that naturally follow. By means of the rays I have treated patients upon whom caustic had been previously applied, and in which there had been scar formation and a recurrence. I have succeeded not only in eliminating the disease, but even the scar, which had formed and drawn the eyelid downward, was softened and relaxed, so that the ectropion practically disappeared.

(6) Even in advanced cases, in which further destructive treatment is out of the question, one can often destroy the disease and yet retain all the healthy tissue. It must be understood, however, that the deeper and more advanced the disease is at the beginning, the less chance there is for complete recovery.

(7) In very advanced cases, in which one cannot reasonably hope for recovery, one may still retard the disease, prolong life, lessen discharge, diminish the color, relieve pain, and make the remaining days of the patient more comfortable and more hopeful.

By modern deep technic many cases that were formerly considered hopeless to-day have a chance of getting well. In many cases the results can be much hastened, and probably rendered more satisfactory, by complete destruction—first by means of the high-frequency current, and then follow immediately with a full dose of rays, which extends slightly beyond the area affected. If the disease

has extended to the glandular system, one must always treat this thoroughly, just as in deep-seated malignant disease.

Epithelioma of the mucous membrane is much less favorably influenced by this form of treatment. This statement will, however, apply to every form of treatment. The tendency for recurrence and metastasis is much greater. Success has been attained even in this location, but I believe the rays should not be depended upon alone.

Epitheliomata of the mouth and lip may be taken as examples of involvement of the mucous membrane, and the statements made can be applied to the same disease affecting the nose, vagina, and rectum. In all these cases I first destroy the disease thoroughly by means of the high-frequency current, either by the spark or by electrothermic excision. Following the destruction of the disease by this method I then give a thorough course of treatment by means of the Röntgen rays, both to the area affected and to the adjacent lymphatic glands.

Rodent Ulcer.—This disease, which is so similar to epithelioma, may be considered in conjunction with it. It was the results obtained in the treatment of rodent ulcer by the X-rays that first attracted serious attention to radiotherapy. Generally speaking, I believe the results obtained are not quite so good as in epithelioma, but superior to any other form of treatment. The reason for not obtaining as good results is the fact that these cases tend to come late after mucous membrane has become involved.

DEEP RÖNTGEN THERAPY

So much has been written recently under this title that it seems folly to condense the knowledge within a few paragraphs, and I can do nothing more than state briefly the principles involved.

Previously stated, the encouraging results obtained in the treatment of deep-seated disease are due to the fact that proportionately more rays are made to reach the deep areas than formerly. This is accomplished first by the use of the filters, generally from one to three millimetres of aluminum, which absorb the soft rays which otherwise would be absorbed by the skin and cause damage. At the same time the more penetrating rays are permitted to pass and reach the deeper tissues before being absorbed. This only lessens, but does not eliminate, the danger of burns.

The second principle governing deep therapy is the use of the cross-firing method, which has been used in America, more or less, for ten years, but which has been gradually developed until the points of entrance of the rays have been increased many times. As an example: ten years ago, if we were treating a carcinoma of the uterus, applications would have been made anteriorly and then posteriorly, but in each application the rays would have been allowed to distribute themselves generally either over the anterior or posterior surface of the pelvic cavity. At present the anterior surface of the pelvic cavity is divided in from three to fifty areas. A full dose is then sent through each particular area of skin, directed toward the deep-seated disease, but in each application all the surrounding tissue is protected by means of lead foil so that no single area of skin will receive more than one full dose. The posterior pelvic outlet is divided to a lesser degree. In this way many times more rays reach the deeper tissues than would have been possible by former technic and as a result it is possible to obtain much more brilliant results.

In the same way these principles, illustrated by carcinoma of the uterus, are applied in the treatment of deep-seated disease anywhere.

Carcinoma of the Uterus.—Only a few cases of carcinoma of the uterus are yet on record as having responded to the effect of the rays, but these have been brilliant and give us hopes for greater results in the future.

Uterine fibroids have been treated extensively, and in some of the leading gynaecological clinics of Europe it is accepted as the chief or only method of treatment. The work is being gradually worked up with enthusiasm in America. The cases most suitable for treatment are those beyond forty years of age, who are approaching the menopause, but the treatment need not be limited to these. The younger the patient, the more treatment will be required and the less brilliant the results, but when it is a question of either sacrificing the generative organs of a woman or treating her with the Röntgen rays, I believe that the latter method is preferable. As a result of the treatment there is a cessation of hemorrhages, an improvement in general health, an increase in weight, and gradual disappearance of pains and pressure symptoms. There is usually little or no result during the first month. There is generally decided improvement at

the end of the second month, and the patient is generally cured in from four to six months. During this time the patient is able to go about her usual duties, and is not interfered with, excepting during the time of actual treatment. The rays in practically all instances will bring about the menopause, and there is, of course, likely to be the same group of symptoms that accompany a normal or spontaneous menopause, and are to be dealt with on exactly the same lines.

The treatments at present are usually given in series; that is, the abdomen is divided into a number of areas, depending upon the case, and a full dose of the penetrating, filtered rays is given through each of these areas. These doses may be given on the same day or on different days, depending upon circumstances, but after they have all been given there should not be a repetition inside of two or three weeks, at which time the full series is to be repeated. It is desirable to begin these treatments immediately after a menstrual period, or at least ten days before the time for the succeeding menstrual period. When the hemorrhages are continuous one should calculate from the probable time of the menstrual period.

CARCINOMA OF THE BREAST

The Röntgen rays have proved themselves of most value up to the present time in the postoperative treatment of carcinoma of the breast and in the treatment of recurrences, metastases, and inoperable carcinoma. Some patients who had inoperable carcinoma have been rendered free from symptoms for several years. Many cases have shown disappearances of recurrences and metastases, and because of the disappearance of the carcinoma in inoperable cases, in recurrences, and in metastases it is now generally admitted that the Röntgen rays have a most beneficial effect as a postoperative measure in all cases of carcinoma of the breast.

The general principles governing all deep-seated treatment must be applied here. They are: thorough filtration, cross-firing with penetrating rays in large quantities, carefully measured, and carried to, but not exceeding, the erythema dose.

In all postoperative treatment the patient should be treated on the principle that there is likely to be disease still present. In the treatment of recurrence it should be continued until all evidence of

the recurrence has disappeared. In the treatment of inoperable cases it is advisable to treat from all directions so long as the tumor continues to decrease. When it becomes stationary, in some cases it will have been reduced to an operable stage, and can then be removed. We believe that it is advisable to treat only metastases that have not become generalized.

TREATMENT OF SARCOMA

The results obtained in the treatment of sarcoma are more satisfactory than in carcinoma. My results show recovery of about fifty per cent. Sarcoma of the bone, I believe, gives better results than sarcoma of the soft tissues. In these bone sarcomas there is only partial reduction in the size of the tumor, but there is a general increase in the deposit of lime salts until the bone assumes the solidity of normal bone and remains well.

In sarcoma of the soft tissues it is sometimes advisable to excise, when it can be done with reasonable completeness, and then follow with thorough radiation by the deep technic referred to above.

Medicine

SOME CLINICAL INDICATIONS OF SENILITY *

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I suppose that the term senility, as commonly used, is intended to express the more obvious indications of old age, such as illustrate an advanced degree of decay of many parts of the body, and especially a failure of the powers and functions of the brain. These conditions are sometimes regarded and described as a "second childhood." Before discussing these ultimate degrees of senility, I propose to direct your attention to some of the earlier phases which are of more particular importance for us to note in our capacity of clinicians,—phases which we do well to perceive for the reason that some of these processes may admit of treatment which may serve to check and materially delay their progress. Some of these early failures may not be seriously observed by the patient himself, or by his relatives and friends. If we are to avert or modify these textural changes, we must note them in their early stages. Prevention, here, as always, is better than cure.

This matter relates to a study which has not hitherto received much attention from clinical observers, viz., an investigation respecting the *personal* and *inherent vitality* of each individual, one of much difficulty, but yet capable of yielding useful factors in framing a prognosis in the course of many diseases. We are all familiar with the fact that many persons are old for their years, and others remarkably young for their age, as years count. We may well inquire as to the reason for such remarkable differences. It is, perhaps, too commonly assumed in such cases that premature old age is the result of a careless and sensual life, of overwork and strain, of unwholesome occupations, often aggravated by alcoholic

* Lecture delivered at the London School of Clinical Medicine.

and other vicious excesses. This is, no doubt, a frequent occurrence. We meet, however, with many instances, in both sexes, where such a past history applies in no degree, and where plain signs of senile failure are setting in soon after middle life. How are we to account for them in such cases?

We must go back here to the family history on both sides, and discover, if we can, other cases of early familial decay, or inquire as to ancestors who have lived what are called "hard" or unwholesome lives. An inquiry as to the ages at death, or the occurrence of grave constitutional diseases, in members of the families is necessary. Especially should we note the particular habit of body, or diathetic proclivity, in these families, for these throw much light, at times, on these cases.

We are accustomed, and rightly, to lay stress on the fact, when it is correctly ascertainable, of longevity in the ancestry, especially when we are examining persons for life insurance, and this, of course, holds good as an element for prognosis in the hazard of many morbid states. We then seek to determine the degree of inherent vitality proper to the individual patient before us, and try to form how he will withstand or overcome his particular ailment. We may well combine this inquiry with some of the modern methods which we employ, as, for instance, in cases of pneumonia, when we regard the count of hæmic leucocytes as an indication for prognosis.

The premature occurrence of gray hair is a factor readily magnified as an early symptom of senility. It would be unsafe to lay much stress on this tissue-change. The tendency is often familial in both sexes, and by itself does not count for much. If we take this in connection with recognized changes in the arterial tunics which point to sclerosis, we are on more safe ground. The latter degeneration is a much more important element wherewith to test the approach of senility. "On a l'âge de les artères," as an eminent French clinician declared. Early signs of arterial thickening may be regarded as more gravely indicative of senility than any other symptom. We may, however, remember that some of these local sclerotic changes may not be significant of similar changes throughout the body. Thus, indurated radial arteries in a laborer may not be regarded as evidence of a similar condition in the cerebral or coro-

nary arteries. An estimation of arterial blood-pressure is important in judging of this matter. We know that this tends to increase with advancing age, and we can compare the figure attained with the normal one for the age of the individual. Inquiry as to the occurrence of any of the predisposing causes of arterial sclerosis may throw light on any case; thus, syphilis, abuse of alcohol and animal food, a gouty habit of body, lead-impregnation and continued vascular strain may explain this precocious senility in any individual. We may note two instances of arterial decay, the tough and the brittle, in respect of physical qualities, the latter being, as Sir William Jenner used to teach, more liable to break down and cause hemorrhage, illustrating a fatty degeneration. Thus, arterial changes are apparently more apt to occur in subjects of the arthritic habit of body, especially in goutily disposed subjects.

Some recent observations by Dr. MacCordick, of McGill University,¹ supported by Professor Adami, are of much interest in this matter. They prove that the rigidity of calcified arteries is distinctly less during life than after death. We know that the lime salts are certainly present in the *intima* or *media* of these vessels, for they are disclosed by the X-rays in any subject with calcified arteries. It is now proved that the deposit during life is in a condition akin to wet or "unset" mortar, and only sets hard after death, under the influence of carbon dioxide and the rapidly-diminishing alkalinity of the blood. The so-called "air" (which gives the derivation of the word artery) in the arteries after death is largely composed of carbon dioxide. Hence, the calcified arteries during life are never so rigid and pipe-stem-like as they speedily become after death. Dr. MacCordick suggests that this fact explains why calcified arteries do not rupture so frequently as might be expected, and indicates that many of the gross changes, such as ulceration of the *intima*, plates of lime, etc., are induced *post mortem* by the sudden hard-setting of the lime deposits. Had these ruptures of endothelium occurred during life, there would have been, he believes, conditions present to induce thrombosis and gangrene in various parts of the body, sequels not commonly met with.

The occurrence of an *arcus senilis* has been commonly regarded as an indication of general premature senility. Observation of

¹ *Brit. Med. Journal*, Oct. 18, 1913, p. 980.

many examples of this local degeneration does not support this view. I have known of instances where this local fatty change in the cornea has existed from early manhood to an octogenarian stage. Premature death of parts of the body is constantly occurring. Thus, a young man may become bald and lose most of his hair irrecoverably at an early age. Another may lose his teeth by rapid decay. These are but indications of defective quality of these particular textures as laid down *in utero*. It is probable that the same conditions of premature atrophy occur to some extent in other tissues and organs of the body without entailing early death, though, no doubt, modifying the general health in various ways; and so we meet with inadequate functions on the part of various organs, as the kidneys, liver, thyroid gland, pituitary body, and other textures.

The influence of a strumous or scrofulous habit of body has obviously a determining power in inducing premature senility. A subject of this condition comes into the world ill-equipped for the battle of life. He has the most vulnerable of bodily tissues, and reacts badly to all form of injury or infection which he may encounter. He is beyond all others the prey for the bacilli of tubercle, and his tissue-resistance is feeble. If, unhappily, there is a conjoined taint, or infection, as we now regard it, of syphilis, we have the worst soil conceivable for any peccant matter to alight upon. The infantile victims of inherited syphilis have long been recognized as stunted subjects of premature senility. Indeed, may we not regard an inadequately treated subject of syphilis as a prematurely aged person, in spite of an originally good constitution, however robust he may appear, when there is possibly looming in the distance for him such sequels as parasyphilis, general paralysis, arterial disease, and aneurism?

Among early signs of progressive interstitial nephritis which may be noted before any obvious renal symptoms are recognized is a mental condition which sometimes tends to marked nervous irritability and explosive temper. Another indication is that of increased emotional excitement which is apt to occur on slight provocation, accompanied by a readiness to shed tears. Fits of hilarity and laughter may end up with weeping in such cases. (I think that Sir Clifford Allbut first directed attention to these symptoms some years ago.) A glistening condition of the conjunctiva, due to œdema,

may be often noted in such cases, without obvious œdema in other parts.

You will note how essentially clinical are matters of this kind, and how impossible it is to gather such facts in laboratory researches. The clinical laboratory, however, will afford proof of renal inadequacy in such cases, and indicate the appropriate treatment, dietetic or other, for them.

Ossification of the costal cartilages before the sixth decade may be regarded as a premature senile change. It is not certain if this is due to an excess of lime salts in the blood, although there may be simultaneous wasting of the bones in such cases, with increased outpouring of lime salts determined to other textures, including cartilage.

Such senile defects as occur in ordinary cerebration may usually be traced to defective arterial circulation leading to brain decay. Lapses of memory for names, and forgetfulness, are among the earliest to be noted. A tendency to tell the same story over and over again within an hour or two is a well-recognized sign of brain failure. These symptoms begin to be common after the seventh decade. Sometimes they are realized by the individual. They may continue for many years, and are less manifested by those who remain in active work than by those who imprudently decide to lose touch with the business of their lives. Thus, the man who retires from his regular occupation and has few other interests in life is apt to degenerate, both mentally and physically, sometimes very rapidly, and before he has reached the allotted span of life. A hobby may long avail him to retain his mental activity, and the golf ball to-day is not seldom one of the beneficent agents for this purpose.

When winter and spring sometimes very unwisely unite in matrimony, a rapid mental and bodily decay may be expected to overtake the wintry partner. The physician should forbid the bans in such cases.

A venereal taint and a persistent immoderate use of alcohol in any form have much to do with premature senility, and bear heavily on the arterial and vascular textures of the body. The finest constitution naturally resists these toxic influences longer than weakly ones. Thus, cirrhosis of the liver is longer averted in the patrician than in the plebeian for many reasons. The average laborer be-

comes senile sooner than most men. His life of strain, exposure to all kinds of weather, and his misuse of bad liquors fully explain this fact.

In arthritically disposed persons, the occurrence of nodosity of the joints, especially of the terminal digital phalanges, in the form of Heberden's nodes, is regarded by some observers as an indication of longevity. They are often met with in persons who have few classical symptoms of gout, and probably the majority of those who reach eighty or ninety years of age are not free from this trophic change. Dupuytren's contractures, and the camptodactylia of Landouzy (incurved little finger), are among indications of a gouty habit, and are not truly rheumatic lesions. They may occur in middle life.

I think it may be noted that the daughters of gouty men are more apt than others to afford indications of early bodily failures. They suffer from many weaknesses, miserable digestive power, and enfeebled nerve powers. They become thin and gray-headed. They respond badly to most methods of treatment. (I am sorry for the husbands of such women.) We note that they often escape many of the classical symptoms of gout, but they show signs of subacute changes in their joints, and are not seldom plagued with attacks of eczema—atonic gout, in fact. Some of these women become very obese, and may develop glycosuria of varying grades of severity.

Prostatic enlargement before the sixth decade is reached is an early manifestation of senility. Indolence of the bladder, with slow micturition, is often met with after sixty years of age without any obvious prostatic symptoms. All elderly men should be instructed to give plenty of time to each micturition, and should always empty the bladder as completely as possible. Catheter life, as it is termed, should be postponed as long as it is safe to abstain from entering upon it.

Among common senile symptoms we recognize the occurrence of widely-spread catarrhal conditions affecting the nares, pharynx, and the larger bronchial tubes. This leads to a form of *tussis senilis*, with a free flux of mucus which is often rich in sodium chloride—the “salt rheum” of mediæval writers. Fits of sneezing sometimes accompany this condition, and are helpful in clearing the bronchial tubes. Hence we do well sometimes to aid expectoration in the case of the aged, with defective muscular power, by using some sternuta-

tory powder, as snuff, for this purpose. Such subjects are always liable to fresh accessions of bronchial catarrh, and trifling exposure often leads to an onset of pneumonia which proves fatal.

The main line of treatment for early manifestations of senility may be concisely expressed by the term "physiological righteousness," as described by Sir Andrew Clark. We have to note the degree of constitutional vigor or vitality in each individual, the measure of the tokens of the specific habit of body, and the personal equation. We may often recognize, if we will, the features and tissue proclivities of the father descending, as a rule, along the female line in the family, while those of the mother pass on to the male descendants. Symptoms pointing to nervous instability demand marked attention. Thus we take note of the occurrence of chorea in sensitive, nervous children who become infected with the provoking toxin of rheumatism, a plain signal of early cerebral instability. As Cheadle pointed out, the nervous child in a rheumatic family is the likely victim of chorea or cerebral rheumatism. We pay attention to the vascular system in respect of arterial changes and the degree of arterial blood-pressure; to early indications of renal inadequacy; to orthostatic albuminuria, and tendency to epistaxis in young subjects, and we may gather from these our method of averting further harmful progress.

"Moderation in all things" is the keynote of the prescription to stave off premature senility, and it is certainly no easy task in these days to carry out this precept. Hurry, strain, excitement, and too much pleasure are everywhere predominant now. Educational and athletic strain, insufficient rest and sleep, improper dietary, and inappropriate teaching are all too common, and natural physiological life is depressed and checked in consequence. The body wears out too soon, and we dare to call this "progressive civilization"! Home-training and parental discipline are dying out among us. The child is old before he is young, stimulated when he should be at rest. Small wonder that we have so many weaklings among us, unfit to fill up our national forces, stunted, toothless, and aged before they reach their natural development! No one is to be punished for naughtiness, and so we grow hooligans and viragoes.

These are some of the sad reflections which are borne in upon us as guardians of the public health when we calmly consider the phases of premature senility. We note that party spirit and debased

polities, with mawkish sentimentality and loose thinking, are destroying both the Christianity and the character of our people. The only remedy I can foresee to meet all this evil is "universal service," which, in my opinion, would bring us together in both higher physical and moral attainments. These are no days for shirkers and ease-lovers, if Britain is to hold her rightful position in the world.

As I close, you will not fail to have noticed that I have not referred to the opinions of Metchnikoff in respect of senility and its cause. Any views of so eminent a pathologist demand attention and respectful consideration. You remember that he regards old age as depending on extreme phagocytic action, leading to wasting of the viscera and tissues by the irritation of various toxins of microbial origin. He suggested that life may be prolonged for many years by combating these vicious processes, and subduing these intoxications with their proliferating macrophagi, by introducing into the intestine antagonistic bacilli. The best for this purpose he conceives to be a Bulgarian bacillus or lactic ferment, and this has been largely used of late years under the names of "*Lacteol*" and "*Fermen-lactyl*." This has had its little day among the novelties, now so numerous in modern therapeutics, but as to the influences of this *elixir vitae* in adding one hour to any human life I have no facts to report to you. Our descendants in the twenty-first century may have more to record in the matter. Personally, I am disposed to be sceptical both as to the cause and effects, but I have no doubt that these ferments are useful in combating (temporarily) various harmful products of disordered digestion, and so benefiting the general health. Metchnikoff's treatment would require to be a daily dietetic habit of every person approaching senility, a sour milk for our second childhood. It is almost forgotten by some people that "our mortal bodies were not made to last for ever."

(For those of you who may be further interested in the defects and processes which are to be noted in advancing senility, I cannot do better than refer you to a recently-published work on the whole subject from the pen of Professor Saundby, of Birmingham, which is the most valuable and detailed contribution on the subject that has yet been presented to the profession. I have merely touched to-day on a few points which it is well to consider in reviewing some of the earlier and more prominent features of senility.)

VAUGHAN'S STUDIES IN SPLIT-PROTEIN PRODUCTS AND IMMUNITY *

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VAUGHAN's investigations in immunity were begun fifteen years ago, and were directed to solving scientific problems rather than to discovering practical applications. From time to time the results of these brilliant studies have been published in American and foreign medical journals, and recently they have been incorporated in a book of 474 pages, from which I have freely quoted. His studies deal with the chemical composition of living matter, especially of bacterial cellular substances, and with the reactions they give rise to in the animal body—in other words, with particulate proteins (bacteria) and their specific ferments.

He states that the only essential and constant difference between living and non-living matter is, that within the molecules of the former there is constant metabolism, which is absent in the latter. Matter is alive when it feeds and excretes. The living molecule not only absorbs, it assimilates. It chemically alters what it absorbs, and within limits it may be altered by what it absorbs. In this constant change between the living molecule and outside matter resides the source of energy; and nitrogen seems to be the master element in the living molecule.

The cell is not the unit of life. Life is molecular. The cell is not only made up of protein molecules, but its form and function are determined by the chemical structure of its constituent molecules. The lines along which the spore, seed, or ovum develops are determined by the chemical structure of its proteins. Growth in other directions is impossible, and this accounts for stability in reproduction.

* A review presented at the monthly meeting of the medical staff of the University of Pennsylvania Medical School at Dr. Alfred Stengel's office, February, 1914.

Bacteria are essentially particulate, specific proteins. Bacteria are usually classified as microscopic plants, but Vaughan has failed to find the presence of cellulose in their structure, though some bacteria contain two carbohydrates, neither of which gives reactions characteristic of cellulose. He concludes that the greater part of the bacterial cell is made up of true protein. He does not consider the fats and waxes which are found in relatively large amounts in certain bacteria, notably the tubercle bacillus, are essential constituents of the living molecule, but rather specific products of the life activities of the bacteria. Chemically bacteria are essentially nucleoproteins, or glyconucleoproteins, and, while morphologically simple, chemically they are complicated in structure, being composed of complex proteins which bear a close resemblance to the cells of the higher animals. They require the same kind of food, which they select, assimilate, and excrete in the same way, and the conditions of their life, with favorable and unfavorable influences, are much the same.

All true proteins contain a poisonous group. Vaughan and Wheeler first found that the cellular substance of certain pathogenic bacteria could be split up with the liberation of a poisonous substance. They then tested non-pathological bacteria, then animal and vegetable proteins, and all with the same result. They not only all contained a poison, but the *same* poison so far as its gross effects on the higher animals were concerned. He does not think that these poisonous bodies obtained from all proteins are chemically identical, but physiologically they are so closely similar that their action is identical.

The protein poison split off from the typhoid bacillus, from egg-white, and from edestin of hemp-seed, kills animals in the same doses with the same symptoms and with the same lesions. This is striking evidence of the similarity in the structure of the protein molecule, whether it be of bacterial, animal, or vegetable origin. Upon this he constructs the following theory. All proteins are constructed on the same model and contain a chemical nucleus, archon, or keystone. This is the poisonous group and is practically the same in all proteins. One protein differs from all others in its secondary and possibly its tertiary groups. In these latter lies the specificity

of proteins. When the primary group is detached from its own secondary specific groups, it manifests its poisonous action through the avidity it has for the secondary groups of other proteins.

The chemical nucleus does not become a poison until stripped, in part at least, of its secondary groups, and the intensity of its poisonous action is determined by the thoroughness with which the secondary groups have been removed. When the highly complex protein molecule is disrupted by chemical agents or enzymes the chemical nucleus or poison is set free, more or less completely; and to the extent that it is released from combination it becomes, in the presence of living proteins, a poison, because it disrupts the same. The best agent to disrupt the protein molecule and obtain the largest yield of poison is a 2 per cent. solution of caustic soda in absolute alcohol.

The pathogenicity of a bacterium is not determined by its capability of yielding a poison. Non-pathogenic bacteria yield just as much of the protein poison as the most highly pathogenic, and the proteins of our food contain the same poison that is found in pathogenic bacteria.

The pathogenicity of a bacterium depends upon its ability to grow and multiply in an animal body. This means that the invader converts the proteins of the animal into its own proteins, transforms native (the host's) proteins into foreign (its own) proteins. The accumulation of foreign proteins can result only from the destruction of the native.

All living cells grow by means of their own digestive ferments, and these must act upon the pabulum within their reach. If the ferment of the bacterial cell cannot digest and prepare food for the bacterium from the body proteins, then the invading bacterial cell dies. The second factor in determining whether a given bacterial cell will grow in the animal body is the effect of the ferments of the body on the invader. If these are rapidly and thoroughly destructive, there is no bacterial development and the organism is innocuous. Thus the *prodigiosus* is not pathogenic, but the cellular substance of this bacillus is highly poisonous to animals. It is not, then, the lack of poison in the substance, but its ability or inability to grow in the animal body by means of ferments, which determines its pathogenicity. The smallpox virus is pathogenic to the un-

vaccinated, but non-pathogenic to the vaccinated, because by vaccination there has been developed in the body a ferment which destroys the smallpox virus before it can develop.

All fermentations are of cellular origin. This does not mean that ultramicroscopic forms of life or non-particulate living organisms, if there be such, do not produce fermentations. It would probably be better to say that all fermentations are the products of living organisms, and that there can be no living organism which does not produce its specific ferment. Life cannot be conceived of without ferment action, because all living things must feed, and food assimilation without ferment action is inconceivable.

Vaughan's idea of an infectious disease is as follows: An infective agent is any protein which possesses the capability of growth in the animal body. He illustrates this by typhoid fever. The infective agent is the typhoid bacillus, a specific, particulate protein. It is infectious because by means of its digestive ferment it can feed upon the proteins of man's body. This means that it can convert man's proteins into typhoid proteins and thus multiply its kind. Having found admission to the body, it proceeds to grow and multiply, and this continues through the period of incubation, which in this disease is about ten days. During this period of incubation there is no effective resistance on the part of the body-cells to the growth and multiplication of the foreign protein. During this time the man is not sick, and Vaughan concludes, therefore, that it is not the growth of the foreign protein which *per se* gives rise to the symptoms of typhoid fever. However, during this time the body-cells are being prepared for their combat with the foreign protein by developing the power of producing a specific proteolytic ferment. When this new ferment begins its action the first symptoms of the disease appear. The active stage of the disease, with its symptoms and the lesions induced, marks the period over which the parcenteral digestion of the foreign protein extends. Death may come from too rapid breaking up of the foreign protein by the body ferment and the consequent liberation of a fatal dose of the foreign protein poison, which is always formed on the disruption of the protein molecule, or it may result from some lesion induced by the products of this disruption, such as perforation and hemorrhage, or it may follow from chronic intoxication and consequent exhaustion. In other

words, all the symptoms and lesions are directly caused by the action, either local or systemic, of the cleavage product, the protein poison of Vaughan and Wheeler.

Fever is one of the most easily recognizable effects of this process of parenteral protein digestion. While natural infection and fever are due to living proteins, experimental fever can be induced by repeated injections of foreign proteins; and by changes in size of dose and intervals between doses Vaughan has been able to induce fever of any desired type. The great majority of clinical fevers are wholly protein fevers, and result from the parenteral digestion of proteins.

Natural immunity to any infection is due to inability of the infecting agent to grow in the animal body. This, of course, does not include toxin immunity, which is a very different thing and is dependent on the presence in the body of an antitoxin, or of something which destroys or neutralizes the toxin.

He repeatedly emphasizes the distinction between the character of the immunity due to ferment action and that due to an antibody or antitoxin. Ferments are not antibodies or antitoxins. The phenomena of anaphylaxis, for instance, are dependent entirely on ferment action or the production of a specific proteolytic ferment. A toxic serum owes its toxicity to a ferment which splits up the proteins of the animal's body, setting a poison free. The substance elaborated in the organism by an anaphylactogen is not an antitoxin. The side-chain theory evolved by the genius of Ehrlich best explains the action of toxins and antitoxins; and while Vaughan does not subscribe to all the details of this theory, yet he believes that when a living cell is attacked by a destructive ferment or a toxin it tends to elaborate an antifермент or antibody.

But the number of pathogenic bacteria which produce toxins, at least in appreciable quantity, is small, and the action of toxins and antitoxins in infections due to those organisms which do not produce such bodies is of minor importance. Since all bacteria—in fact, all living cells—produce ferment, and since every ferment, so far as we know, may lead cells acted upon by them to produce antifерments, there may be some toxin and antitoxin action in all infections, but in most bacterial infections such action is overshadowed by processes much more powerful in their effects. In this

connection his views on the mechanism of diphtheria are interesting and illustrative. The organism finds lodgement and the conditions for growth favorable in the upper air passages. Here it grows in mass and may kill by mechanical obstruction. It produces its soluble, diffusible toxin, which has the properties of a ferment and splits up the proteins of the body, setting free the protein poison. In case of recovery, or in the production of antitoxin in animals, the body-cells elaborate an antiferment or antitoxin which neutralizes the toxin and prevents its cleavage action. The bacilli in the throat are not destroyed by natural recovery, nor by cure with antitoxin, but the action of the toxin is prevented by the antibody. Thus, in his opinion, it is not the toxin itself which kills, but a cleavage product which results from the action of the toxin on the proteins of the body; in other words, the liberation of the split-protein poison of Vaughan and Wheeler. He would classify such substances as diphtheria toxin and tetanus toxin as specific ferments, since it is his belief that these substances are not poisons in themselves, but liberate poisons through their ferment action.

The immunity which is due to recovery from an infection is the result of the development in the body during the course of the infection of a specific proteolytic ferment which immediately destroys the infection on renewed exposure. In most instances it seems that the immunity induced by one attack of an infectious disease is not absolute, but only relative, and may be overcome by severe or prolonged exposure to the virulent form of the infection. Second attacks of even yellow fever, typhoid, and smallpox may rarely take place.

Immunity established by vaccination is similar to that induced by an attack of the disease, because the vaccine is the same protein that causes the disease. It must be so modified that it will not induce the disease, yet so little altered that it will stimulate the body-cells to form a specific ferment which will quickly and promptly destroy the infecting agent on exposure. The smallpox virus is modified by passage through a cow, the anthrax bacillus is converted into a vaccine by growth at high temperature, and the typhoid bacillus is killed by heat. It seems reasonable to suppose that the protein retains its capability of sensitizing so long as there is no radical alteration in its chemical structure. The possibility of

obtaining vaccines from the split products of pathogenic proteins led, in part at least, to some of Vaughan's investigations upon which he is still working.

The statement which Vaughan first made in 1907, that protein sensitization and bacterial immunity, which appear so far apart, are in reality identical, has since met with wide acceptance.

Protein sensitization consists of the development in the animal body of a specific proteolytic ferment which digests the same protein on reinjection. Protein sensitizers may be living or dead, particulate or in solution, but soluble proteins sensitize more readily and more fully than those not in solution.

Cell permeation by the foreign protein is probably essential to the perfect elaboration of this process, but when a foreign protein is introduced into the blood of an animal it soon leaves the circulating fluid and is distributed throughout the tissue. This latter fact has been demonstrated by independent investigators. This is true of both particulate and soluble proteins, but the distribution is more prompt and effective with soluble proteins, and this explains why the latter are more efficient sensitizers. It should be borne in mind that a protein relatively insoluble *in vitro* may become more readily soluble *in vivo*.

Vaccines, then, according to Vaughan, are protein sensitizers, and this brings up one of the more important problems in scientific medicine now awaiting solution; namely, the preparation and proper employment of vaccines. Vaccines are now used enormously, not only by way of preventive inoculations but also as a means of curative treatment. Preventive inoculation has already been shown to rest on a logical scientific basis, but much of the vaccine therapy of to-day is highly irrational. The action of a vaccine in both relations, either preventive or curative, depends on the same principle,—that is, protein sensitization,—and the protein of the organism responsible for the diseased condition existing in the body and that of the therapeutic vaccine must be identical or closely-related bodies. In most, if not all, of the systemic infectious diseases the infecting organism sensitizes the body either throughout or over large areas. To expect vaccines to act beneficially in such conditions is most irrational: the defensive powers of the body are already taxed to the utmost, without adding additional work from the in-

jection of a vaccine; but there are local infections in which the area of sensitization is limited and circumscribed: the defensive powers of the body have not been stimulated as a whole. Such diseases, as shown originally by Wright, may be treated rationally with vaccines, provided such agents can be obtained in such forms that they will act both effectively and harmlessly. The future of vaccine therapy depends upon our ability to secure such vaccines. So far this is largely not yet possible, but the results in this direction have met with enough promise to lead us to be hopeful of ultimate success, while admitting present failure. In strictly local infections the proper use of a specific sensitizer may cause the more general and abundant formation of a specific proteolytic ferment which may aid in the destruction of the infecting organism. But it should be clearly understood that with every protein injected into the body a most potent poison is also introduced.

In this connection it is interesting to review briefly his work with the tubercle bacillus, because on the score of the protein poison in tuberculin he explains the tuberculin reaction, and largely condemns the use of tuberculin for therapeutic purposes.

The cell poison of Vaughan and Wheeler is obtained, as already stated, by splitting up the cellular substance of the tubercle bacillus with alkali in absolute alcohol. When given in sufficient quantity this poison kills both healthy and tuberculous animals within one hour. When given to healthy animals in very small repeated doses it has no visible effect. In larger repeated doses it causes in healthy animals a condition of chronic intoxication. When given to tuberculous animals, even in very small repeated doses, it intensifies the tuberculous process. It does not sensitize, it will not give rise to anaphylactic phenomena, it produces no allergy. There is no evidence that it elaborates any antitoxin. It is purely and simply harmful and a poison.

The non-poisonous split product or residue obtained by the same chemical procedure is more interesting; and in this product there is, according to Vaughan, the one small ray of hope of finding among the split products of the tubercle bacillus a body which may possibly be of service in the treatment of incipient and localized tuberculosis. This product has no recognizable ill effect on healthy animals, either in single or repeated doses, either large or small. It

sensitizes guinea-pigs to the tubercle bacillus. If men as well as guinea-pigs can be sensitized with this product, there is the possibility that it may be used to bring into existence and activate a specific bacteriolytic ferment which will split up and destroy a few bacilli in the human body, but we can readily see that this might be harmful rather than beneficial when the number of bacilli in the body is large enough to furnish a dangerous amount of the poison when set free.

As he has shown that the only effect of the protein poison is harmful, either killing by its poisonous effect in large doses, or producing a chronic intoxication if given in repeated doses, he warns that there is no preparation of the tubercle bacillus which should be used in the treatment of tuberculosis until the poisonous group of the tuberculous protein has been thoroughly removed. Practically all tuberculins as at present prepared do contain this poison, especially such preparations as bacillary emulsions, watery extracts, and suspensions of the dead bacilli; and this is, he says, too powerful a poison to be injected repeatedly, even in small doses, into the animal body.

Vaughan has treated patients with a 1 per cent. solution of the non-poisonous cleavage product of the tubercle bacillus, and states: (1) It is of no value in advanced pulmonary tuberculosis. (2) It may prove harmful even in early cases if the dose is too large, or if small doses are too frequently repeated. (3) When properly used in initial cases or in localized tuberculosis, its action is apparently prompt and specific. (4) He believes that in initial cases this preparation is preferable to any form of tuberculin.

He further states that as tuberculin does not sensitize, or does so imperfectly, it raises a serious question as to its employment as a therapeutic agent. If it is not a sensitizer, its therapeutic good effect, if it has any good effect, must be confined to the possible establishment of a tolerance to the tuberculo-poison. Sensitization to tuberculo-protein can be induced by bacillary emulsions, by watery extracts, and by Vaughan's non-poisonous cleavage product. If the sensitization secured by the last-mentioned agent is as good as that produced by the others, it has the advantage of not containing any poison. On the other hand, if the therapeutic effect desired consists in the development of a tolerance to the tuberculo-poison, tuberculin must

be preferred, unless we should use the more completely isolated poison.

Vaughan, however, believes tuberculin to be an excellent diagnostic agent, because its relatively simple structure favors its prompt cleavage when injected into an animal already sensitized by the tubercle bacillus. In other words, the proteolytic ferment already called into existence by the tubercle bacillus splits up at once the tuberculin into the toxic and non-toxic groups. It is the action of the toxaphor group, whether systemically or locally (as in the eye or skin), which causes the inflammatory reaction with which we are familiar.

Let me repeat that Vaughan lays special emphasis and continually insists that toxin immunity and bacterial immunity are radically different. Attempts to describe one of these forms of immunity in terms of the other are unwarranted and lead to confusion. The protein poison is not a toxin. It elaborates no antibody; and, while its repeated use in non-fatal doses may establish a certain tolerance, it gives no immunity comparable in either *nature* or *degree* with that obtained by like employment of toxins.

The protein poison is not specific, and the tolerance which may be secured by the protein poison is not specific. The protein poison of Vaughan, the primary protein archon, is a poison pure and simple. It does not sensitize, it will not give rise to any allergy nor anaphylactic symptoms. It is the secondary protein groups or cleavage products which are specific, do sensitize, and do produce immunity and kill by anaphylactic shock.

The sensitization developed by a protein is specific, but is not due to the poisonous group in the protein, which is much the same in all proteins, as stated above, but to its secondary groups, for it is in these that one protein differs from all others.

The different proteins have certain predilection places, and the symptoms of a disease are largely determined by the location of the foreign protein. The pneumococcus accumulates in the lungs, the smallpox virus in the skin, the typhoid bacillus in the spleen and mesenteric glands, and the tubercle bacillus in the lungs, though the latter has been a parasite so long that it may grow on any human tissue. The most skilful physician may not be able to tell what organism is responsible for a meningitis. The symptoms of acute

miliary tuberculosis and those of typhoid fever are much alike. It is the location of the infective agent, rather than its exact nature, which gives rise to the more or less characteristic symptoms of the different infectious diseases.

The protein poison elaborated in all the infectious fevers is the same physiologically, whatever its source—coccus, bacterium, spirillum, or protozoan. The specificity which characterizes the infectious diseases is not due to the poison formed, but to the protein cause and the specific ferment produced.

In this great and suggestive book, which I have attempted so inadequately, I fear, to review, Vaughan further discusses in special chapters and in great detail these toxic and non-toxic groups in relation to different infections, notably anthrax and the pneumococcus; and also the specific ferments of the cancer-cell. He reviews the literature and discusses at length anaphylaxis or protein sensitization in its various phases. He discusses the parenteral introduction of protein and the attendant phenomena, especially protein fever; and in the final chapter outlines fully, from his point of view, the phenomena of infection.

If in a single sentence one would be so rash as to attempt to give Vaughan's fundamental idea, I should say that he believes it to be a biologic law that when a cell in the animal body is permeated by a foreign protein the former strives to elaborate a ferment by which the latter is destroyed, and believes that this forms the foundation of a correct understanding of many of the problems of immunity and disease.

INSOMNIA: FOOT TROUBLES; RHEUMATISM AND GOUT

A LECTURE PREPARED FOR THE COURSE ON PSYCHOTHERAPY AT FORDHAM UNIVERSITY
SCHOOL OF MEDICINE

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INSOMNIA is an affection from which in our time a great many persons suffer. Popularly, at least, it is supposed to be a serious affliction which often leads to damaging results. Sensational announcements of various kinds are often made as to the physical and mental effects of prolonged insomnia upon the sufferers, until those who have any of the slightest symptoms of it are apprehensive of the worst. Wakefulness is supposed to indicate some serious pathological condition in the brain which is almost certainly progressive and with consequences that can be better imagined than described, but that are greatly to be dreaded. Young people, particularly, who are thus affected are quite sure that, even if there are no immediate results, their mental vigor, if not their physical strength, will be impaired and a future of damaged vigor and probably increasing inability to work be the result.

The affection is becoming much more frequent, and there has been so much talk about it in recent years that those affected are ever growing more solicitous. The consequence is that a great many people are using remedies of various kinds to produce sleep, women particularly, though men also of sedentary occupation who live much indoors are learning to take certain drugs to produce sleep, and constantly find more frequent occasion to use them. The sale of these remedies at the present time is enormous, and new ones are constantly coming on the market, though any physician whose practice in nervous diseases is reasonably extensive is likely to have patients come to him who are still using the old-fashioned remedies, and evidently have been tinkering with them for a long while.

The story of most of the somnifacient remedies that we have is interesting, instructive, and, it may be added, profoundly discouraging. When the coal-tar products came into common use a generation ago, two classes of very helpful drugs were found among them; at least, these drugs favorably affected certain symptoms that had been hitherto rather hard to modify and still harder to control. Coal-tar preparations for the reduction of fever and the production of sleep came in with a rush, and were widely used. The antipyretics had their period of greatest employment about the time that grippe was so prevalent, when, indeed, it was a pandemic, and when, therefore, there was abundant opportunity for the use of antifebrile remedies. I need scarcely recall the fact that the initial satisfaction from the use of the antipyretic coal-tar remedies was soon succeeded by profound disillusionment with regard to them. They reduced fever rather promptly, but they acted very unfavorably on the heart, they depressed the general system, they probably disturbed the blood-making organs, and though, in addition to their antipyretic quality, they appeared to act most beneficially as anodynes, their ultimate usefulness was very questionable; indeed, more than one physician of distinction and of thoroughly acute clinical observation declared that they probably did much more harm than good.

At about the same time certain coal-tar preparations were also found to be of great use and apparent benefit in insomnia. Every physician knows the list, and knows how widely their harmlessness was advertised, and for the moment how beneficial they seemed to be. Every physician of twenty years' experience knows, too, not only how disappointing they proved eventually, but also how many serious results followed their administration. In succession a number of them proved to have serious deteriorating effects either upon the blood-making organs directly, or indirectly upon the composition of the blood. When used continuously for a prolonged period, various blood dyscrasias developed that were much more serious than the original insomnia either had proved or was likely to prove.

At the present time a number of other coal-tar products and chemical remedies of various kinds are much lauded as somnifacients. In spite of past unfavorable experience, many of them are used by physicians, though, of course, used with much more care than was the custom when the original coal-tar somnifacients were introduced to

us a generation ago. We do not know just how these drugs act, any more than we knew how the original remedies of this class produced their effect. Probably any remedy that will so act upon the system as to produce somnolence, and, more important, so as actually to produce sleep, is likely to have rather serious effects upon the general health. Much less than this could scarcely be expected from them, since they are capable of producing such a profound modification of life processes.

It is easy, then, to understand that, in spite of the frequency of their employment and the fact that, apparently, physicians must sometimes use them because patients must have something to help them to sleep, physicians, as a rule, would prefer not to prescribe such remedies, and would be glad to have other means to produce sleep or, at least, to do away, if possible, with the condition of mind and body which causes wakefulness. Probably nothing would be more welcomed at the present time than such a mode of treatment.

For any satisfactory treatment of insomnia the first and most necessary preliminary is to form some idea as to what produces the condition. Direct causes do not often exist, though they can sometimes be found; but indirect causes of many kinds are present in nearly every case. The more one analyzes the living conditions of those who complain of insomnia, the more does it become clear that what these patients need is not a remedy that will produce sleep by some unexplained knock-out process that we can not but suspect of ulterior unfavorable effects, but a change in the mode of life that will predispose to natural sleep. Some of the details of living that the physician finds when he elicits the history of his patients are most interesting. Sometimes they show at once to just what the insomnia is due, and indicate without any possibility of error just what must be done before there can be any genuine hope of relieving the sufferer.

Not long ago, while spending a week-end with some friends in the country, I was asked by the hostess to give my advice with regard to what she described as a severe case of insomnia in her daughter. She had taken a number of remedies, but the family objected very strenuously, and on good grounds, to the use of such drugs, and advice of various kinds given by physicians had proved ineffectual. The young woman lay awake every night practically until two or three o'clock in the morning, and as they were old-fashioned people, and breakfast was

a family function at which every one was expected to be present, and as she was scarcely fit to come to table after such a night of restlessness and wakefulness, her empty place was a frequently-repeated admonition of the probable seriousness of the condition.

During the course of a single day at the house, I noticed that the young lady in question, a very charming girl of rather high-strung nervous temperament, had taken four cups of coffee. I found out on inquiry that a fifth cup had been brought to her room with her breakfast about half-past nine in the morning. When, therefore, the patient and myself had a heart-to-heart talk over her insomnia, I suggested that her coffee was the probable cause, and that if I took five cups of coffee during the day I thought that I would not sleep at all in the next twenty-four hours; that even a small cup of coffee taken any time after nine o'clock at night would keep me awake until two or three in the morning. I was told at once that she could not think of doing without her coffee. She had become quite dependent on it; at least, she thoroughly believed so. I said then that one thing was clear, and my advice would be very simple: she must choose between her coffee and her sleep. If she preferred to take coffee and do without sleep for a considerable part of each night, well and good; only in that case she ought not to complain, nor to consider herself as suffering from any real ailment, as she was deliberately postponing the hour of her sleep because she preferred to do so.

Among the less well-to-do, unless they are Germans, it is likely to be tea rather than coffee. I recall a case of considerable complaint about wakefulness and light sleep, in which various remedies had been tried with but little satisfaction. The patient developed an eczema of rather acute character, that proved quite intractable. Careful inquiry into her habits of life elicited the fact that she was taking from fifteen to twenty cups of tea a day. The patient was a cook in a family of the better class, and made fresh tea for herself five or six times a day. She was quite sure that the tea could do her no harm because she made it fresh so often. She told me that her friends of the same calling among less well-to-do people kept a teapot on the stove practically all day long, putting tea into it every now and then, and she was quite sure that they would be harmed, but that she was escaping injury. Her eczema and her sleeplessness were both consequences of the neurotic condition which she was actively developing

by her habits as a virtual tea-topper. Eczema, much more frequently than is thought, has a neurotic basis of this kind, as dermatologists clearly recognize, and careful inquiry should always be made as regards the tea habit, especially of those who work around kitchens.

The taking of various stimulants is likely to be one of the first subjects of our inquiry, though some of the stimulants may not be recognized or may escape detection because of their unusual character. I have seen school children suffering, not from pure insomnia, but from disturbed sleep with dreams that sometimes waked them, tossing, muttering, even screaming occasionally, in their sleep, and whose ailment was supposed to be some form of indigestion or other gastrointestinal affection. They were out so much and were so tired at night that they were not kept awake, but their parents had been rendered very solicitous by their disturbed sleep. A little careful investigation showed that they were in the habit of taking as a drink one of the much-advertised stimulating drinks that may be obtained at soda fountains. A number of these concoctions which are very commonly taken by young folks and have become a favorite tipple even with children of school age and under contain, I believe, or did contain at that time, a definite amount of caffein in each glass. These children, who lived in an apartment hotel, were taking several glasses a day, and in warmer weather took three or four. They were consuming practically as much caffein as would be contained in the same number of cups of coffee, and the effect upon their sleep can be readily understood. No amount of treatment directed to their stomachs or intestinal tracts would have availed to relieve their distressed sleep.

Other habits, however, are likely to make just as serious inroads on sleep at night. Not long since I was consulted by a broker who complained rather bitterly of his inability to sleep at night. He went to bed about twelve, and it was often three in the morning before he got to sleep. He was not taking any coffee except a small cup in the morning, and, though he was indulging in an occasional high-ball, there seemed no reason to refer his sleeplessness to this, and otherwise he seemed to be in excellent physical condition. An investigation of his habits of life, however, showed that every day on coming home from his office, usually between half-past four and five, he took a bath, always warm, at least at the end, and then lay down for a couple

of hours until dinner time. It was seldom that he had less than two full hours of sleep in the late afternoon. After this it was easy to understand why he did not sleep in the early part of the night. Women are much more likely to have such habits than men, and occasionally one finds that a woman living in an apartment hotel has her breakfast in bed about nine o'clock, stays there to read for a while afterward, dozes some, and does not get up until after eleven. It is quite unlikely that she will be able to get to sleep for at least fifteen or sixteen hours after that time. There are people who can sleep more than one-third of the day, but almost any cause will postpone their going to sleep if they have slept during the preceding fifteen hours.

Occasionally the difficulty is temporary, and due to some change in the mode of life. Here in New York those who move, particularly in May, when people are likely to keep their windows open, to a house not far from the elevated road, and particularly if it is on the line of the elevated itself, are almost sure to be kept awake by the recurring noise of the trains. The wonder is how so many people can sleep in spite of the fact that a train rolls by their window once every ten minutes or less all through the night. It shows how little noise has to do with prevention of sleep, once one becomes accustomed to it. There are probably half a million of people in New York City whose windows are wide open for five months in the year, with the trains running by at short intervals. The attempt, then, to secure a noiseless place for patients suffering from insomnia is usually misdirected. It is not noise that keeps people awake, but an oversensitive nervous system, and it is this that must be treated, unless, of course, the noise can be readily stopped.

Indeed, I have known a prominent physician suffering from insomnia who found that he could sleep better on a train than in his home on a quiet street of one of the most quiet of our cities; at least, it has the reputation of being quiet. He would be wakeful night after night for three or four nights until the insomnia would so affect his nerves as to make his work very difficult for him; then he would buy a sleeping-car ticket for a seven-hour ride on a midnight train, sleep quite well, and come back refreshed for his work the next afternoon. It was a comparatively inexpensive though somewhat time-consuming remedy. As, however, he was writing a text-book, and often had a good deal of manuscript to correct, as well as proof to look

over and books that he wanted to read, he would take these with him and do some solid hours of literary work on the train. I have known men to try to build themselves absolutely sound-proof sleeping apartments, and fail. I have known the same men to sleep very well in a rather noisy camp and, above all, to sleep without a break in the midst of all the jar and rustle and creak of a fast-going steamer at sea. This demonstrates that it was not noise that kept them awake, but their own oversensitive condition which emphasized the irritation due to sounds.

For many people who complain of sleeplessness the most important question is with regard to the amount of fresh air that they get. It will be found that many of them stay in the house most of the day, or ride out in a closed carriage to make a few calls or to go to their offices. Lack of sleep produces a certain loss of control over the external blood-vessels, and in consequence a sensitiveness of the skin to cold. Many of these people feel a little shivery when in the cold air, and avoid it by staying in the house or keeping their carriages or autos rather tightly closed up. A vicious circle is formed, loss of sleep causes sensitiveness to cold, and this makes them shun the air, thus increasing the sleeplessness.

Probably nothing so promotes good, sound sleep as an abundance of air both during the day and night. Men who have been sleeping very poorly for weeks or months will sleep well on board a steamer, not only getting their full quota of seven or eight hours at night, but they will have a nap, sometimes of several hours, in the morning and again in the afternoon. In spite of this indulgence, which on shore, under ordinary circumstances, would surely keep even normal people awake, men and women who have previously slept badly are usually not wakeful even in the early part of the night. Some hours in the air before going to bed, especially if this can be secured quietly and without hurry or bustle, will often make poor sleepers sleep very well. A ride in an open car, or on top of a bus, or in an automobile that does not go too rapidly nor over quite level streets, is better than any sedative of which I know. It will produce the desired effect in nearly every case.

It is particularly important that the sleeping rooms of those who complain of insomnia should be thoroughly aired and not too warm. This does not mean that they should undress in a cold room, nor get

into bed between cold, damp sheets, for this will produce wakefulness, will drive the blood away from the surface to the large organs, particularly to the brain, and will almost surely prevent sleep. They may undress in another room, as a bathroom, and their sheets in damp weather should be warmed before the fire before they get into bed. Cold feet are often the cause of wakefulness for an hour or two in winter. The best thing is not to try to warm them by a stove, which takes too long, but soak them in warm water, gradually heated to the point that is just tolerable, until the feet are thoroughly warmed.

The great English surgeon, Sir Henry Thompson, declared that he knew of nothing that was more conducive to sleep after a busy day, and particularly after a busy evening or a night of some excitement owing to a dinner or other social function, than to put the feet into a bath-tub of warm water, and gradually increasing the heat of the water to tolerance. The feet should be kept in the water until the lower limbs half-way up to the knees are thoroughly reddened, then well wiped, and sleep will come readily soon after getting into bed. As Sir Henry Thompson lived to be well beyond eighty, and found this procedure of special advantage as the years went on, it is apparent that there is no danger in it even for those of advanced years; indeed, it is probably the simplest and best remedy for wakefulness early in the night that we have.

It is much more effective, however, in the winter than in summer. In warm weather a cool sponge bath, taken rapidly and followed by rubbing with alcohol, the surface of the body not being wiped dry, is often extremely effective in producing that opening of the little blood-vessels at the surface of the body which is so conducive to sleep, and one of the regular accompaniments of normal sleep. Vigorous men sometimes find a cold bath or a cold shower to be effective for this purpose; but, as a rule, the nervous, especially those under weight and unaccustomed to vigorous exercise, find the shock of the cold bath or cold douche too great, and will be made somewhat irritable by it.

Many people seem to think that they do not sleep because they are not sufficiently fatigued. Sometimes they take a great deal of exercise, occasionally in the gymnasium, with the idea of tiring themselves into such exhaustion as will surely be followed by sleep. I have often seen this method fail entirely; it is not exercise that is needed, but air. In strong, healthy men, who in earlier years were accustomed to a great

deal of exercise and the free use of their muscles, a sedentary occupation may lead to wakefulness, and exercise may be needed; for this the individual case must be studied. The popular impression, however, with regard to exercise and its relation to sleep is quite erroneous, and I have often known people to be so tired that they could not sleep for very fatigue. On the other hand, I have occasionally known old people, especially those of asthmatic tendencies, who were apt to be wakeful at night, particularly after more exercise and excitement than usual, to rest much better after taking a cup of coffee. The stimulation of their circulation apparently distributed the blood throughout the body, and prevented its accumulation in large organs, especially the brain.

Besides wakefulness at night there may be wakefulness in the early morning. Some people find this even more annoying and disturbing for their day's work than wakefulness early in the night. Something arouses them between five and six o'clock when they are not accustomed to get up until between seven and eight, and they lie awake for two or more hours. This is often due, especially in thin people, to lack of food. There is a tradition that the eating of food shortly before going to bed is likely to dispel sleep. Some acute disturbances of sleep, such as dreams of falling, starting due to mechanical interference with the heart action, and the like, may be traced sometimes to meals eaten just before bedtime. But the human animal, like all other animals, has a strong tendency to sleep when its belly is full; we do not expect a child to sleep with its stomach empty, and it is generally recognized that when it awakes and cries it needs something to eat or drink. The same rule applies to children of larger growth.

If men or women go to bed more than five hours after their last meal, their stomach is pretty well empty at that time, and there are likely to be cravings for food sufficient even to disturb sleep after four or five hours more. A good rule is that if more than three hours have elapsed since the last meal, particularly if the individual has been in the open air in the meantime, he should take a glass of milk or a cup of cocoa or other nutritious drink, with some crackers or a piece of cake or some simple refection. It is surprising how often this will solve the problem of wakefulness in the latter part of the night, but also not infrequently in the earlier. The people whom I know to sleep the best are those who, after the theatre, drop into a restaurant,

have sometimes a rather elaborate supper, and then, getting to bed at half-past twelve or one A.M., sleep like the proverbial top until eight the next morning.

Many of the traditions with regard to certain foods and their relation to sleeplessness are ill-founded. "Welsh rabbit," for instance, is said to be a great disturber of sleep, yet there are probably, in the words of one of our great daily newspapers, more than a million of Welsh rabbits chased down into stomachs in the large cities of this country every night of the year by people who are among our soundest sleepers. Lobster is supposed to be another offender in the matter of producing wakefulness, yet the lovers of lobster present the fewest cases of insomnia. Lobster and cheese represent special food materials against which certain people have idiosyncrasies. Both of them are particularly liable to degeneration which causes intestinal discomfort and consequent disturbance of sleep; but, apart from these circumstances which are quite accidental, they contain nothing essentially sleep-opposing. The tradition which associates them with insomnia is based upon a combination of these incidents, forgetting that the exceptions to the rule are so many as to make the rule of no significance. They are literally exceptions which prove the rule, that even such foods do not of themselves disturb the sleep.

Not a few wakeful people are under weight, they eat too little, are watching their diet, have eliminated all sorts of nutritious articles from their dietary until they are literally in a state of lowered nutrition. This makes them nervous and irritable, and is the basis of their inability to sleep. Often an increase in the amount of food, taken during the day at other hours than the evening, will do much to make them sleep better. This must be borne in mind, because the tendency to lose sleep is often constitutional rather than local. What is needed is improvement in the general physical condition. Just as soon as that comes, sleep improves. Many sufferers from sleeplessness are constipated, partly from lack of sufficient food, partly from want of sufficient liquid, and these conditions must be corrected before more sleep can be expected.

What is most necessary in the treatment of insomnia is to reassure the patients as to the real significance of the symptom from which they are suffering. Many of them fear that some progressive pathological change is taking place which will inevitably lead to a dangerous,

if not fatal, disease of the brain, or, at least, derangement of the mind. Undoubtedly insomnia is associated with insanity. Some cases of insanity have as an early symptom a tendency to sleeplessness; but this symptom never develops until there are other manifest signs of the mental disease impending or, indeed, already present. The idea which so many people apparently have that insomnia surely leads to insanity, and that most of the insane in our asylums are there because they were sleepless for a certain length of time, their minds having given way in consequence, is quite without foundation.

I have known a number of intelligent persons who had lost, or thought they had lost, a great deal of sleep. Men have told me quite frankly and in all sincerity that they thought they had not slept more than an hour a night for weeks or months, and in one case for years. They were willing to concede that they did go to sleep, but it was only by fits and starts, and their fitful sleeping hours were separated by long intervals of wakefulness. I have had such cases watched over and over again, and have invariably found that they slept much more than they thought. Occasionally, when they have told me that they had slept but little or, indeed, were not sure that they had had a wink of sleep the night before, I have had in my hands incontestable evidence that not only had they been asleep, so that people went into their rooms without waking them, but even that they were audibly asleep.

The fact of the matter is that such people wake a number of times during the night and, not being sure how long are the intervals of sleep between these waking moments, conclude that they have been awake much longer than they have been asleep. As a rule, exactly the opposite is true. It is a common experience to be awakened in the morning by some noise, and to turn over to take another little nap, to wake up with a start after what seems a few minutes, and find that an hour or two have passed. We have no idea as to the length of our sleeping periods, and if we awaken a dozen times during the night we are likely to think that we have been wakeful most of the night, though all the wakeful periods may be embraced within an hour, and the rest have been spent in sleep.

If these people are over-solicitous as to the effect of their wakefulness upon them, they will worry themselves into utter incapacity to work, their appetites will become impaired, and they will be so tired after any exertion that a train of physical evils will be set up which

will seriously impair their health. They will attribute this impairment, not to their worry, but to the cause of their insomnia, or will consider it the effect of that insomnia. It is important, above all, to lessen this solicitude, and to neutralize the effect of the anxiety upon their minds.

While insomnia is supposed to be so serious in its results, it is surprising how many people the physician meets who have suffered from insomnia, sometimes for prolonged periods, without any noticeable ill effects. I have scarcely an old friend among my acquaintances who has not confessed to me that at some time or other in life he had gone through a series of wakeful nights which made him think he was suffering from serious diseases of the brain or mental affection. I have two friends, both physicians and past seventy-five, who for years slept so badly that they were in despair about themselves, were sure that they could not possibly live long, and, since they were burning the candle at both ends, awake both day and night, that old age would come upon them prematurely. One of them is now past eighty, and both are hale and hearty, vigorous in mind and body, considering their age. I have known many sufferers from insomnia, but I have never known one to be seriously hurt by it. I have seen insomnia develop as a symptom of insanity, but never until other marked signs of mental affection were present. Wakefulness is really a passing symptom of a functional nervous condition that never leaves serious effects.

As a matter of fact, the solicitude with regard to sleep is much more the cause of the insomnia than any other factor. People are anxious about sleep, fear that they may not get it, and keep themselves awake by worrying because it does not come to them. Usually there is a physical cause to begin with,—tea or coffee, lack of food, over-fatigue, lack of air, anxiety about something, or a combination of these with a bad habit of some mental occupation that is absorbing taken up at late hours, which makes the individual wakeful for some nights in succession, then worry over the insomnia does the rest. I know people who begin about four o'clock in the afternoon to wonder whether they will sleep to-night or not. At six they begin to pity themselves because other people can sleep so easily and they can not. At eight they are wondering petulantly

why such a visitation should come upon them. Between ten and eleven they go to bed, hoping against hope that they will sleep, but quite sure that they will not. Ten minutes after they lie down they begin to toss disturbedly because they can not get to sleep. Almost surely they will lie awake for hours.

The French say that sleep is like a woman, and must not be wooed too ardently, but a little neglectfully, as if, after all, you did not care very much if she did not respond to your advances. Certainly any one who worries about sleep will drive it away. Those who sleep the best never think about it, but just lie down, think about something else, and fall asleep before they know it. People should not write just before going to bed, nor, if young, read exciting stories, but a quiet book of travels or an old-fashioned text-book, or something read for information will do much to compose the mind to sleep. William Black made one of his characters read the *Encyclopædia Britannica* straight through. He always read it for an hour before he went to bed, and it proved an excellent somnifacient. He was on his third reading at the age of eighty, and for twenty years had had no trouble about sleeping. Even reading in bed may be recommended with confidence to people who think they suffer from insomnia. In the old days when it was a difficult matter to get a good light from over the shoulder for reading in bed, such reading was hard on the eyes. Now that electricity enables us to arrange the light as we will, and pillows can be used to make one comfortable, reading in bed is an excellent preparation for sleep. Professor Osler's suggestion that every one should keep half a dozen of the classics, Plato's "Republic," "Don Quixote," Sir Thomas Browne's "Religio Medici," Burton's "Anatomy of Melancholy," a volume of Shakespeare where one can reach out and get them after getting into bed, is an excellent prescription for the insomniac. Classics are books that every one praises and no one reads, and usually they are well productive of sleep. At the same time a good deal will be gained even by casual association with them.

Any one who is worrying lest lack of sleep is going to produce physical deterioration may be assured that if he or she passes eight hours lying down quietly every day there need be no fear that nature will not take all the sleep she needs during that time. The hours of sleep should, if possible, not be too fixed, so that if necessary one may

lie an hour or two longer in bed in the morning, in case there has been wakefulness the preceding night; but, provided the person has been in the horizontal position for full eight hours, no serious physical consequences need be feared. This idea of itself does more to overcome insomnia by relieving the patients of the dread of its evil effects, for insomnia, like so many other psychoneuroses or functional nervous affections, is at bottom a dread in a great many cases and must be treated as such.

When it comes to the drug treatment of insomnia, I always hesitate to recommend any of the coal-tar products. They have proved treacherous in the past; we do not know their mode of action; they have a definite depressing effect, and, unfortunately, most of them a distinct tendency to produce a habit of requiring them or something resembling them in order that sleep may come. Sleep is such a mysterious dispensation, when natural it represents such a complex relaxation of vascular and nervous systems and such nice adjustment of physical and psychic factors for the temporary obliteration of consciousness, that one can not but hesitate at any trifling or ignorant, hit-or-miss interference with it. The poets have spoken of it as the twin-sister of death, and, while that may seem to those occupied with the material side of the question as a highly imaginative description, it probably represents more for the psychologist than any mere definition in physical terms can hope to do. Sleep is largely a matter of habit. To disturb that habit or to replace for any prolonged period its influence by some drug operation is at least questionable, and can only be undertaken when circumstances absolutely demand it.

Where there is pain, of course it must be relieved. When wakefulness is a true insomnia that is merely lack of sleep because for some reason that mysterious condition will not come, it seems better to use every possible means to tempt nature to reassert her power over the organism rather than to supplant that power by crude and as yet not well understood external means. Supplantation of nature's functions are always at least a little dangerous. Whenever people do not chew vigorously, or, above all, have their food presented to them in such ways that very little mastication is needed, the teeth require much more attention from the dentist than when they are used vigorously. To supply food predigested to the stomach lessens the digestive

power after a time. If anything is done for nature, she has a definite tendency to refrain from doing that for herself, until finally the habit and sometimes the faculty for it is impaired.

The old-fashioned bromides used with reasonable care are still a favorite mode of treatment of mine. Half a drachm is given two hours before sleep, and then if, after half an hour of lying down in *quiet* expectation, sleep does not come, another half drachm prepared in an ounce bottle and kept under the pillow so that there is no need to get up and disturb one's self in order to take it is taken and the patient assured that sleep will come. Almost as a rule slumber ensues without any further trouble. After a time in this mode of treatment the sleep habit reasserts itself, the second dose is not needed, and then gradually the first may be dispensed with.

Even before this drug is prescribed, other remedies of similar nature are tried. I have often found that a glass of milk well covered with nutmeg proves an excellent somnifacient. It does so all the more surely if it is explained to the patient that, while nutmeg is a favorite household spice, it is also a drug which has a place in many of the foreign pharmacopœias, and especially the German, and which is known to have a distinct sedative and somnifacient action. In elderly people I have even ventured occasionally to suggest the addition of a teaspoonful, or even of two teaspoonfuls, of brandy to this, and often with good effect. I should much rather produce a slight alcoholic habit than a craving for coal-tar drugs such as I have sometimes seen. There is, however, very little danger of this. The recommendation of alcohol in any form, however, is never made to those who are thin and of nervous disposition. For them the stimulant always proves exciting rather than sedative. To those who are used to it a glass of beer or, better still, a glass of porter will often prove of good service. I have known a simple glass of porter take the place of a coal-tar drug with excellent effect and without any evil consequences. Alcohol used distinctly as a drug may be of service.

In some of these cases I have preferred not to give the suggestion for the brandy directly, but rather to supply a prescription containing a considerable amount of alcohol, as, for instance, the compound tincture of cinchona, sometimes even strengthened with a certain amount of *spiritus frumenti*. It is well to know where the prescription is to

be compounded then, and to be sure that it is not frequently refilled. Not a little of the supposed good effect of proprietary remedies which in recent years have been sold so extensively is due to the alcohol that they give. There is no good reason why with proper precautions physicians should not take advantage of this, though, of course, the individual patient must be carefully studied in order to prevent the formation of a dangerous habit.

Indeed, the whole treatment of insomnia is a question of finding out as much as possible about the individual, his habits of life, and especially all that regards sleep, food, air, and exercise, and then modifying every possible factor that may influence wakefulness. In this way it will be found that only rarely is it necessary to use any of the directly somnifacient drugs, and the patient can be retaught the habit of sleep which for the moment has been interrupted.

FOOT TROUBLES

Foot troubles are very common in our time. There are very few people indeed who do not suffer in some way from their feet. This is not surprising when we consider all the circumstances of modern life, for there are many reasons why the feet should resent the treatment accorded them by a great many people in our time. As a rule, we are ever so much heavier as a people than we used to be. An Irish visitor who came to this country declared some time ago that the American people were travelling under false colors so far as the symbolism of their natural caricature is concerned. He demanded to be shown the tall, thin men of the type of Uncle Sam, spare, muscular, well knit, without an ounce of superfluous flesh. He thought that since Uncle Sam was built that way, Uncle Sam's wife ought to be something of the same type. He declared that he had seen no thin people to speak of since he came to the country. Practically all the women over twenty-five were distinctly stout. As for the men, they nearly all looked as though they had swallowed a watermelon whole and it was still inside of them. There is no doubt that the paunch as an American institution, especially in our cities, is becoming extremely frequent—and prominent, which, etymologically, means projecting forward. It is only rarely that for men over thirty the tailor does not have to cut his cloth with some

idea of making the customer appear a little less stout than he really is. Large clothing manufacturing firms are said to employ clever cutters who can make stout suits appear elusively less projectile than they are. They are paid high salaries to make the wearers of the suits look, if possible, more sylph-like than their actual appearance. The Greeks used to introduce such optical corrections into their great architectural monuments in order to prevent certain lines from looking curved. They called this process of optical correction *entasis*, and our genial tailors in modern times are applying the same principles with a great deal of success, especially if the fashion plates can be taken as any criterion.

The feet are carrying a larger weight than ever, on the average, in our generation then, and yet have much less vigorous exercise. At least two-thirds of the people in our large cities scarcely ever go up and down stairs any more. When at business during the day they use an elevator; in their homes in apartment houses they would not think of using the stairway—and, indeed, the stairway is not meant for general use, but is only a dark and winding fire-escape meant to be an auxiliary to the elevator in case of danger or accident.

Besides, what city dweller ever walks any distance in our time unless on a prescription from a physician? Almost it is true that the school-boy who has to go half a mile takes a trolley car. Everybody else has no hesitation about riding whenever the distance is more than five or six blocks. Indeed, it is surprising how many short rides are taken on trolley cars. This is for the middle classes. For the upper classes they use their automobiles constantly, until actually there is not even the walk to the corner that one had to take in order to get a trolley or some other form of conveyance. The automobile comes to the door, and the only vigorous exercise that the master and the mistress of many houses get every day is going up and down the steps at the front of their houses on going out and coming in.

Besides, the standing occupations have increased very greatly. The restaurants have multiplied in recent years. Restaurants used to be rather infrequent, and one had to walk a few blocks to get to one. Now in the business districts of cities there are two or three quick-lunch places on practically every block, and it is rare to find

a block anywhere in a city that has not some sort of an eating-place or at least a delicatessen store on it. They are all well patronized by the people of the immediate vicinity. This has greatly increased the number of waiters, besides lessening the amount of exercise that a large number of young folks have to take in order to get their lunch. Men used to walk a mile, or even more, rapidly in the middle of the day in order to have warm lunch at home, or they did not mind walking a series of blocks in order to get to a favorite restaurant for their lunch. Now no one would think of doing anything like that, but goes to the eating-place just around the corner. Business men lunch in the building where their offices are very often, and not infrequently their meals are brought in to them.

Our banks have multiplied greatly, and most of the workers in banks stand a great deal. Our clerks in the large stores particularly constitute a much larger part of our population than before, and under very different circumstances from the work in smaller stores. Sitting down for certain portions of the day was not uncommon in the smaller establishments, and then, besides, clerks were more actively engaged. They went up and down stairs, they had to take customers from one portion of the store to the other, or they had to go some distance to get articles wanted; they even were asked to go outside the building sometimes for various duties connected with their occupation, and they were not limited to a little space of twenty to thirty feet behind a particular counter, from which they were not expected to move all the day, except for a rather short time at lunch hour.

It is standing and not walking that is hard on the feet. It interferes with the venous circulation particularly, and thus disturbs the internal nutrition and the general vitality of the foot. In the pressure exerted on the foot the thick-walled arteries are very slightly, or probably not at all, compressed. The thin-walled veins are likely to be compressed, however, and, as a consequence, the return circulation is interfered with. One can study the mechanism rather simply in the hands. If the hands are allowed to swing free while one takes a long walk, a certain swelling takes place which gives a distinct sense of fulness in the palm and fingers. The venous blood is not entirely returned, and the hands feel thick and a little awkward to use for some time afterward. This is one of the reasons why men

carry a cane; for the use of it and the pressure produced by it help to empty the veins and so correct the tendency toward venous congestion. Athletes, runners, and, especially, long-distance walkers often carry corn-cobs or something of that kind in the hand, on which the pressure is exerted, and thus blood does not collect in the hands.

Not only are the feet dependent, but the pressure of the body on them, with the weight of bodies ever growing more heavy in our time, still further delays the circulation. It is not surprising, then, that the tissues of the foot should be less vital and should gradually yield to the strain put upon them; hence the frequency of flat-foot or, as it is sometimes euphemistically called in our time, weak foot. It is sometimes said to be hereditary, because it frequently occurs in families, and perhaps there is an hereditary tendency. But a much more important factor is undoubtedly the frequency with which members of the same family follow the same occupation and do about the same things in the same way as those around them.

At any time, then, when there is complaint of any pain in connection with the foot or leg, flat-foot has become so common that an investigation should at once be made. If there is flat-foot even beginning, then no other pathological condition should be thought of as existing until reasonable treatment has been provided for the weakened arch so as to see whether this is not the whole cause of the trouble, whatever it may be.

Ordinarily it is assumed that the pains of flat-foot are limited to the foot itself. On the contrary, very seldom are the initial symptoms referred to the foot, or at least not to the under portion of it, but to the ankle, the lower leg, the knee, the thigh, and sometimes even to the hip and back. Pain in the knees is an extremely common initial symptom of a yielding arch. The reason for it is that the falling of the arch requires the use of muscles around the knee in quite a different way mechanically from that to which they were hitherto accustomed. Hence the achy tiredness which develops in beginning flat-foot. This is always worse in rainy weather, and makes the patient think of rheumatism. Great tiredness of the legs is nearly always due to some yielding of the arch. Whenever one set of muscles becomes very tired all the muscles of the body share by sympathy in this tiredness, and the consequence is often a sense of exhaustion

which makes sufferers think that they must have some deep-seated constitutional disease, or surely they would not have such severe symptoms.

Gallery tire, as it is called, illustrates very well the reflex generalization of muscles which takes place whenever even a single muscle is overtired. People visiting picture galleries become over-fatigued because, being unused to much employment of the superior muscles of the eye, these grow exhausted, and this is reflexly communicated to the muscular system generally. The whole mechanism is manifestly a safeguard to prevent the abuse of any one muscle or group of muscles to exhaustion.

As a matter of fact, these patients suffering from flat-foot because there is often some slight swelling of the feet in the evenings after they have been standing on them all day are sometimes treated for kidney trouble or some other organic affection. Their tired feelings are so complete as to seem more than local in origin. In women, and especially in young women, their trouble is often supposed to be genital in origin, especially if there are pains in the back, and one finds constitutional treatment, or even local applications, and especially douches, suggested for it.

Whenever there are combinations of symptoms due to other affections there is almost sure to be the conclusion that all the symptoms must be referred to the same cause, and then a constitutional disease is surely thought of and very frequently diagnosed. I have seen, literally, dozens of young clergymen who had some trouble with their larynx because they did not know how to use their voices, and who complained of their knees because they had the initial symptoms of yielding of the arch with consequent overstretching of muscles and tendons around that joint, in sad states of mind because they thought they were suffering from some constitutional disease. Their laryngologist specialists assured them that they were suffering from some form of the uric acid diathesis or the rheumatic diathesis, inquired carefully whether their fathers or mothers had suffered from rheumatism in any form, and then insisted that their clergyman's sore throat, an entirely local condition due to wrong use of the vocal chords, and their painful knees which they noticed particularly coming down from the pulpit or the altar after they had been standing perfectly still on their feet for

some time, were manifestations of overacidity of blood, which they must treat by rather a severe regimen in order to avoid any further accumulation of acid in their system.

They are told, almost as a rule, that they must not eat red meat, that they must avoid acid fruits, that they must be careful about certain vegetables, and the consequence is that their general nutrition is often disturbed by too great limitation of their diet. I know that that sounds almost like an exaggeration or an unpleasant fiction, but I have seen just this succession of incidents so often that I have no hesitation in saying that there must be, literally, thousands of people in this country who are having their diet carefully regulated to avoid overacidity of their blood just because they happen to have flat-foot. All the trouble they have is local and needs local treatment, but they are suffering greatly in mind from the thought that they have a constitutional affection that is quite serious and is likely to be progressive, and will probably eventually cripple them seriously and perhaps even confine them to bed for many years of life.

THE RED-MEAT SUPERSTITION

In the present state of our knowledge the insistence on the difference between red and white meats, and, above all, the emphatic direction of patients that they must not eat red meats, though they may take all the white meats they care for, has absolutely no scientific confirmation in serious observation. It is usually supposed that there has been demonstrated to be a very great chemical difference in the nitrogenous content and in the amount of extractives in the two kinds of meat, and that red meat is much more likely to form uric acid, the purin bodies, and other really or supposedly deleterious products in the system than the various white meats. Anyone who tries to find any justification for that idea in our serious scientific literature will have a long search, I fear. On the contrary, it is comparatively easy to find analyses which show that there are no marked differences in the amount of nitrogen or its compounds or of extractives between the two kinds of meat. Even fish and chicken give analysis figures very much like those for the different kinds of red meat.

The medical impression in the matter is simply a superstition.

James Russell Lowell suggested that a superstition, supposing the etymology of the word to be from the Latin *superstes* (the genitive of which is *superstitis* and the meaning of which is a survivor), might be defined as a survival of an opinion from a previous period of thought, though the reasons that were supposed to justify it have disappeared or are no longer known to be existent. There are, of course, many superstitions in medicine, and they are not alone popular, but are accepted by many physicians. The public still uses electric belts and electric insoles and little electric batteries, just as it was deceived by Perkins tractors and the little frictional electrical machines of a century ago. When the Leyden jar was first introduced to the scientific world, little Leyden jars that we would look upon now as scarcely more than amusing toys were carried around Europe and "cured" everything, from headache to indigestion and from rheumatism to paralysis due to apoplexy.

It is extremely difficult to get rid of old opinions. Not a few physicians, and most teachers of physiology in our schools, are quite sure that the old idea that the gastric juice can be diluted by water to such an extent as to make it ineffectual for digestion represents a great scientific truth. On the contrary, we know now that a rather plentiful use of fluids aids digestion and the absorption of food. We are now quite sure that the reason why banting or obesity cures forbid water to a great extent is because the digestion and absorption of food is less complete under these conditions when small amounts of fluid are taken, and, as a consequence, the individual does not derive so much nourishment from his food. We sometimes have the feeling that some of these old ideas may have some truth behind them, due to clinical experience, but with regard to the red meats this is very doubtful, and practically every physician who still clings to the old superstition is quite sure that it is not because of vague clinical observation but on account of very definite scientific knowledge that he is prescribing white meats and proscribing red meats. For this he can get no good authority, and until we are able to determine this no one is justified in forbidding red meats and allowing the white. If he wants to cut down the meat eating, let him do so, but not in this indirect, unscientific way.

The ordinary family physician does not often miss flat-foot any more. The specialists (especially the throat and nose specialists),

the gynaecologists, and, I am sorry to say, some of the general surgeons, do seem to miss it or some of its significance rather frequently. A number of the specialists of the face, eye, ear, nose, and throat seem to be very much convinced of the existence of the uric acid diathesis and other constitutional conditions related to what used to be called rheumatism and which the French call arthritis, and they keep constantly referring symptoms that their patients have in other parts of the body to this constitutional condition. They are now almost the only upholders of the worn-out uric acid diathesis, but they are often flagrant offenders. All those who know anything about the chemistry of the body have quite given this up. But the specialists and some of the older practitioners who began the practice of medicine more than twenty years ago, and apparently, above all, all the attendants at the various sanitaria throughout the country, are deeply occupied with it. This does not refer to the tuberculosis sanitaria nor the asylums for the insane, but the many institutions that receive and treat neurasthenies and sufferers from other neurotic or vague general disorders.

After rheumatism, gout is the most frequently impugned as the cause of foot troubles. This is particularly likely to be the case if the localization of the pain is in the big toe. Apparently it is a fixed idea in the minds of a great many physicians that anything that causes redness and swelling in the region of the big toe is gout. There are certain cases in which sore heels, and especially those due to standing up (strap-hanging) in cars while they go around curves, and start and stop and otherwise disturb already overtired feet, are attributed to gout. Unless there is some other good reason for thinking of gout, these diagnoses of the disease founded on local pain are practically always wrong.

I do not see very many patients, and particularly not many suffering from foot troubles supposed to be either rheumatic or gouty, and yet in the last three years I have seen at least a dozen patients suffering from what was declared to be gout, either in the toe or the heel, who have had nothing more than local conditions. Usually they have been treated with alkalies and colchicum in some form or other, and occasionally they have been taking wine of colchicum for prolonged periods for their supposed gouty condition. Much worse than this, however, has been the effect on their minds of thinking

that they are suffering from a constitutional disease, the prognosis of which at best is rather dubious, which is almost sure to relapse, and which very frequently produces gouty kidney and other internal conditions that distinctly shorten life.

The cases that I have seen where a mistaken diagnosis of gout was made have had a bunion in every case, and have had an inflamed condition of this bunion. A bunion is, of course, a bursa produced by irritation over an exposed joint surface which is being irritated for any reason. It is a water cushion very interestingly manufactured by Nature in order to protect the underlying irritated tissues. It may occur anywhere, and organ-grinder's bursa over the anterior superior spine of the ileus is the most interesting. If the irritation is kept up after the bursa has been formed, almost inevitably an infection of the bursa takes place and then an acute bursitis develops. It is this condition that over and over again—if my own experience means anything—is taken for gout. I do not think that a bunion ever forms unless under very abnormal conditions, except in flat-feet. When the arch drops, if the individual is rather muscular in spite of the weakness of the arch of the foot, there is a pull made on the big toe which has a tendency to pull it outward—that is, toward the other toes. When the arch drops, the distance which the tendons to the toe have to traverse is distinctly longer than it was before. In order to overcome that, the toe is pulled to one side, for thus the end of it is brought a little nearer to the origin of the tendons than before. It is when the toe is thus everted that a bunion forms over the projecting surface of the metatarsal-phalangeal joint by the production of a pocket of fluid meant to protect the prominent joint surfaces from irritation. It is the inflammation of this that causes the pseudogout.

It would seem impossible for such a simple condition to be missed or mistaken for a much more serious constitutional trouble, but I have seen it so often that I am quite sure that such a mistake must happen rather frequently. These bursitises recur from time to time, are particularly likely to develop in wet or damp weather or when there has been much walking in the snow with overexertion of the foot, or when rubbers have been worn, which often are rather tight and compress the bursa, and after the big toe has been red and

swollen and inflamed two or three times the diagnosis of gout seems quite assured.

Unfortunately there is a definite tendency to find supposed constitutional rather than local causes for such conditions. It is ever so much more learned, apparently, to talk of the uric acid or lithic acid diatheses, or of lithæmia, whatever that may mean, or lithiasis, than of flat-feet, or bunions, or even inflamed bursæ. The more carefully individual cases are studied the less will be the tendency to appeal to the constitutional reasons for foot troubles. There is quite enough in what we know of the strain put upon the foot by the increased weight and lack of exercise of recent years to explain most of its symptoms. Why should we go seeking so much farther afield to the disturbance of our patients' minds and to the real detriment of the proper treatment of the case?

As for gout, the more we know about it the more do we attribute it to very definite causation. Most of the cases of gout that have been carefully studied in recent years have proved to be due either to the excessive taking of malt liquors or to chronic lead intoxication. Lead is more important and more direct in its etiological importance than almost anything else. The more we know of the disease the more does heredity or general dietetic disturbance disappear from the etiology, to be replaced by very definite etiological factors. In England the fox-hunting squire who ate abundantly of red beef and drank abundantly of ale acquired gout. It was set down as due partly to the liquor consumed, but largely to the amount of red meat and all sorts of nitrogenous food that he ate. We know now, however, that poor English workmen who can get comparatively little nitrogenous food, and who have very little red meat from one week to the other, but who drink several quarts of ale a day, often acquire gout. The etiological factor is the malt liquor and not the food. Most of our support for the theory of nitrogenous overfeeding as the cause of gout has disappeared.

The physician needs to be very slow, then, to disturb patients' diets in these cases. Some of them are overeating, and then the dietary limitation is good; but many of them are taking just about a normal amount of food, and when their diet is limited they begin to suffer from constipation, tired feeling, sometimes sleeplessness, and general lassitude, which they attribute to the advance of their gout,

but which is often really due to insufficient nutrition under their new dietary regulation, which they are prone to exaggerate. Until tophi are discovered in the ears or there is a very definite set of symptoms proclaiming the presence of gout, foot troubles, in spite of their being complicated by pain in the big toe or in the heel, and even redness, swelling and some fever, should not be attributed to gout—above all, in flat-footed people.

When the question of the treatment of flat-feet comes up nearly everybody now seems to think that the one thing necessary is to wear a flat-foot brace. They are easy to prescribe, easy to get, and that settles the case. Besides, there are a lot of advertising shoemakers who proclaim that they can make all sorts of wonderful supports for the arch, and that all that is necessary is to wear their shoes and then there will be no more trouble. It is doubtful if flat-foot braces, or specially-made shoes meant to relieve flat-foot should ever be advised until exercises have been tried with the idea of strengthening the arch and in that way relieving the painful condition. Just as soon as the metal arch or other appliance is worn an artificial support is introduced, and it is almost hopeless to think that the condition will ever grow better, though for a time there will almost surely be relief of uncomfortable symptoms. A flat-foot brace or arch is, after all, a crutch, and should not be advised unless the patient cannot get on without it. The indication is to restore the normal condition if possible, or, if not, then to develop Nature's compensating mechanical powers to the greatest degree possible.

The principal exercises that are needed are going up on the toes and coming down on the outside of the foot a number of times night and morning. At the beginning only a few repetitions of this movement should be advised, but after a while the movement should be executed thirty or forty times. Besides, people should be advised while combing their hair and dressing and going through other toilet preparations in the morning to go around on their toes. This strengthens the muscles of the calf, and the muscles hold the arch more firmly together, and, besides, the venous blood is thoroughly emptied out of the foot during the course of the exercise and the tissues get a better chance to receive full nourishment. Such patients, too, should be advised whenever they get the opportunity to walk down stairs to take it, and to do so on their toes. Going up stairs is also good,

but it is usually so tiresome that patients will not do it for long. Coming down stairs, however, is easy, and it is good exercise not only for the muscles of the legs but those of the abdomen, it shakes up the liver, stimulates peristalsis, and in stout people is one of the best forms of exercises that can be recommended, apparently bringing about an absorption of fat from within the abdominal cavity when the patient is going down in weight better than anything else.

Many a tired clerk who thinks that he is so exhausted at the end of the day's standing that the worst thing in the world for him would be any further exercise finds, after a vigorous pressing out of venous congestion from the feet by such exercises, that a good deal of his tiredness has disappeared. If he can be persuaded to form the habit of going up and down on his toes a number of times during the day, a great deal of the tiredness of the evening will not develop. If clergymen who stand perfectly still in one position while delivering a sermon of half an hour or more can be persuaded to move around a little and relieve the tension on the muscles of their feet and legs, and even to go up and down on the toes occasionally while preaching, there will be very much less complaint of pain in the ankle and knees than before as they come down from the pulpit.

I have seen the feet of dancers, particularly those of two of the best known dancers on the stage at present, and was surprised to find how much their arches had yielded. The fact of the matter was that in every single joint of their feet there was considerable more play than in those of the ordinary individual. As a consequence the foot was not shapely, and, above all, did not have that curved high instep that is supposed to be the line of beauty in the feet. They had no trouble from their feet, however, because their calf muscles were so well developed that the feet were held firmly, and the exercise kept up the circulation very thoroughly. Undoubtedly when they give up dancing and retire they will have extremely flat feet and will probably suffer severely from them. In the meantime, however, in spite of the yielding arch they have feet that they can use to decided advantage and without any difficulty because of the firm musculature in connection with them and the thorough circulation that is maintained. There is no chance at all for venous congestion with its consequent disturbance of nutrition and increase of sensitiveness.

I would not be considered as opposed to the use of arches or specially-made shoes, but I have seen so many patients benefited by exercises who can afterward wear any well-fitting shoe that I hesitate to condemn people to the servitude of a particular shoemaker or the presence of a foreign body like a steel arch in their shoes. Even the best of them often prove troublesome. The advertisements of the shoemakers in this regard are often impudent quackery. Their one idea is to have as many people as possible who must come back to them to be fitted with their special shoes. In a number of patients I have even ventured to suggest that special shoes that had been worn for some time should be abandoned after the taking of exercise for some weeks, and that there should be return to the ordinary shoe. In some cases this has not been successful, but in most of the instances the patients are glad to be relieved of the necessity of having to wear such special shoes. Quite needless to say, the shoe must always be well fitting and roomy, but not too roomy. A shoe that is too large is always as bad as one too small. In many flat-footed people it actually produces more discomfort than a tight shoe.

Surgery

PYLORIC STENOSIS IN INFANTS *

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THE perusal of recent literature convinces one that there is still a certain lack of agreement between clinicians and surgeons as to whether medical or surgical treatment is indicated in pyloric stenosis in infants. Even among surgeons themselves there is some dispute as to the appropriate type of operation to be undertaken in those cases which are so fortunate as to fall into surgical hands. Recent literature also offers interesting data of distinct diagnostic and pathologic value through the development of radiography by means of the bismuth-meal before and after operation.

Since this subject was first brought to the attention of the medical world by Hirschsprung in 1888, reports of cases have multiplied, and the literature is now voluminous. In this country the splendid work of Seudder, Stillman, Richter, and others has done much to disseminate our knowledge of infantile pyloric stenosis and excite interest in it; and yet, as Seudder states, there is no doubt but that many cases still escape detection, and go down in vital statistics under such headings as inanition, chronic gastritis, gastro-intestinal catarrh, etc.

Autopsy reports and operation protocols are uniform in their description of the presence of a pyloric tumor, which is hard, and free from adhesions to surrounding parts. The whole pyloric stem is thickened, and in cases of long standing the stomach may be dilated and its walls hypertrophied. On section the thickening of the pylorus is found to be due almost entirely to an enormous development of the circular muscle-fibres, an increase in both size and number. The lumen varies, but in marked cases the finest probe is admitted with difficulty.

The etiology is purely speculative, the two leading views being:

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first, that it is a congenital anomaly which progresses after birth, and, secondly, that there is some primary irritation with consequent spasm and hypertrophy. Kaupe, in 1909, after a careful study of 346 articles bearing on this point, concluded that the etiology was still a mystery.

The clinical picture is well established, and so characteristic that having seen one typical example a second is not likely to be overlooked. The diagnosis in my second case was made by the Sister who had observed the first in its hospital course. Nearly all are described as having been healthy at birth; 80 per cent. boys, and the majority first-born and breast-fed, though Rammstedt has recently reported an operated case which was the third child in one family to have the same condition.

Vomiting rarely dates from birth, beginning usually between the second and fourth weeks, and being then persistent and projectile. In my second and third cases the vomitus was thrown a distance of several feet. Bile is usually absent from the expelled material, and chemical examination of the stomach content shows nothing. Constipation is marked and the urine scant. Loss of weight is rapid, and the child, though starved-looking and wizened, is not anæmic, and astonishes one by its bright appearance.

On observation the abdomen appears distended above and flattened below. On taking food the characteristic peristaltic waves are seen resembling a ball being rolled from left to right over the region of the stomach. In many cases a hard tumor can be palpated at the site of the pylorus; this observation varying with different reporters from 25 to 75 per cent. I could not definitely feel a pyloric tumor in any of my three cases examined without an anæsthetic. The diagnosis can usually be made on the above signs and symptoms; but it must be remembered that these vary with the degree of stenosis and that, in consideration of the treatment, pyloric spasm without stenosis should, if possible, be excluded.

The bismuth radiograph is of great assistance in the differential diagnosis. C. J. Mixter, in reporting his study of several cases of stenosis, gives a comparison of the radiograph obtained in this and in other gastric conditions in infants. "In gastro-intestinal indigestion," he writes, "the plate taken immediately after the feeding shows the mass well filling the stomach and tapering down to a more or less pointed end at the pylorus, with some of the bismuth already

in the small intestine. In pylorospasm and stenosis there is a wide departure. There is no sharp differentiation between the two conditions, but the picture produced by pyloric obstruction, whether functional or organic, is typical. Immediately after ingestion the stomach is shown distended, the bismuth evenly distributed, and the pyloric end outlined by the bismuth in a characteristic prow-like, rounded mass. Later bismuth will begin to appear in the intestines, the amount passing the pylorus depending on the degree of obstruction. The bismuth gradually assumes a dense, ball-like mass at the most dependent part of the greater curvature, while the pyloric end maintains its prow-like appearance. When the bismuth becomes balled, the exaggerated type of peristalsis is marked in stenosis, which is absent in pylorospasm." While it may be possible to differentiate sharply extreme grades of spasm or stenosis, there are undoubtedly combinations of the two conditions, and the degree of stenosis also varies, thus making in some cases an accurate diagnosis impossible.

Medical treatment is championed especially by the English and Germans, and operation is resorted to only as a final effort when the baby has become so weakened and emaciated as to make a poor surgical risk—a fact which accounts in large part for the high operative mortality. Robert Hutchinson probably represents the extreme when he states that surgical treatment is never indicated. His treatment consists essentially in gastric lavage and feeding with small amounts at frequent intervals. The vomiting, he states, is thus soon controlled, but there is no gain in weight and sometimes no progress until the fifth month, when suddenly there comes a change and the child begins to gain—a point which Hutchinson calls "rounding the corner." Other paediatricians advise the opposite method of feeding larger amounts at long intervals. Koplik, in a recent article, concludes as follows: "I have practically returned to the first views of Heubner and Pfaundler, and do not submit the vast majority of the cases of hypertrophic stenosis to operation. I regard the prognosis as more favorable under a non-surgical treatment."

Surgically, various procedures have been used—pylorectomy, divulsion, pyloroplasty, and gastro-enterostomy. It is generally conceded that pylorectomy is too formidable, while divulsion offers evident difficulties. The ordinary pyloroplasty operation is unsatisfactory, because of the unyielding structure of the pylorus, and Finney does not consider his operation applicable. In this country

posterior gastro-enterostomy has been so universally employed as to be looked upon as the operation of choice. In a recent review of operative methods, however, Rammstedt recommends a modified pyloroplasty. This consists in incising the pylorus longitudinally down to, but not through, the mucosa, followed by transverse suture or no suture at all, and protecting the incision by wrapping it with omentum. Nicol has combined this with divulsion through a small incision in the stomach. Rammstedt thinks the skill of the individual operator accounts for the good results obtained by Scudder with posterior gastro-enterostomy, rather inferring that this operation offers peculiar difficulties. My experience does not sustain this view; for, except for the small size of the jejunum and the thinness of its walls, there is no more technical difficulty than in the same procedure in adults. Certainly the consistence of the pyloric tumor does not invite attempts at plastic work upon it.

As to the results of either medical or surgical treatment, statistics are, as usual, misleading, for one must consider always the standpoint of the compiler. Thus from the medical side Koplik says that, "inasmuch as 90 per cent. of my apparently hopeless cases have come through without operation, the risk involved in the operative interference is so great as not to encourage us to place any of these cases in the hands of the surgeon." Hutchinson states that in his private practice 17 children treated at home all recovered, while two or three sent to the hospital died. In hospital work he had a mortality of 78 per cent. in 64 cases. He gives the combined figures of four reporters in which there were 66 recoveries in 71 cases. His surgical statistics show only 26 recoveries in 51 cases. On the other hand, Scudder, quoting Monnier, says that the estimated mortality from an expectant medical treatment is between 80 and 90 per cent., and that "upon this carefully-studied medically-treated post-mortem material much of our present pathologic knowledge of the disease is based. The improvement in Heubner's series of cases and in the cases of others who have thought that they have been treating tumor cases with success is to be accounted for upon the basis of a mistaken diagnosis, or a temporary and not a permanent cure." There is evidently, then, some difference of opinion.

The early figures of Scudder on surgical results from 1898 to 1905 show a mortality of 46.5 per cent.,—that is, in cases operated upon during the development period of stomach surgery. The

selected series of Scudder (17 cases, 3 deaths), Stillman (10 cases, 1 death), and Richter (11 cases, 1 death) gives a mortality of 13 per cent. These were all treated by posterior gastro-enterostomy. In 68 cases collected at random from the literature of 1912 and 1913, operated by various methods in this country and abroad, I find a mortality of 19 per cent., representing the work of some twenty surgeons. We can only judge from this that under surgical treatment in skilled hands the present mortality is between 10 and 13 per cent., and in general is below 20 per cent. In considering this it must also be remembered that there were many infants which came to operation *in extremis* after long-continued medical treatment, and that in all of them the diagnosis was established beyond question by the operation; while in any medically-treated series there is an element of uncertainty in the diagnosis, and instances of spasm must be included.

As to late results, Stillman's report of the Pacific Coast cases may be taken as a striking example. Of six children who recovered without operation, one at five years of age was still restricted to semisolid food, a second weighed $7\frac{1}{2}$ pounds at five months, a third $9\frac{3}{4}$ pounds at seven months, and only one was in satisfactory condition, weighing $13\frac{3}{8}$ pounds at six months. The claim has been made that operation would establish an unnatural condition and that digestion would not be normal. Time has well proved the falsity of this prediction, for the babies react quickly, gain rapidly, digest normally, and develop as ordinary children.

Radiography with the aid of the bismuth meal has established the fact that the pylorus remains closed years after operation. In view of these facts it must be claimed that pyloric stenosis in infants is a truly surgical disease, that operation is indicated as soon as the diagnosis is established, and that, too, in suspected cases losing ground under medical treatment operation should not, as is so often the case, be postponed until the baby has become too weak to "round the corner."

My own experience has been limited to three cases. All came early to operation, only one having reached any degree of emaciation, weighing 5 pounds 6 ounces, a loss of over three pounds since birth. Two were operated at seven weeks, and the third at six weeks of age; a posterior gastro-enterostomy being done in each instance. The pylorus always presented the typical stony-hard, olive-shaped tumor

FIG. 1



Case I. Aged 16 months. Weight, 22 pounds
4 ounces.

FIG. 2.



Case II. At time of operation, weight 5 pounds
6 ounces.

FIG. 3.



Case II. Two and one-half years. Weight, 30 pounds.

FIG. 4.



Case II. Bismuth X-ray, two and one-half years, showing all of bismuth passing through stoma.

FIG. 5.



Case III. Aged 8 months. Weight, 17 $\frac{3}{4}$ pounds.

with apparently total occlusion of the lumen. They are now healthy, normally-developing children—three and a half years, two and a half years, and eight months after operation. I have been able to secure a radiograph of the second case, which shows, after two and a half years, that bismuth is leaving the stomach only through the stoma, and none by way of the pylorus.

CASE I.—A. P., male. Seen on July 6, 1910, with Dr. Bowen. The baby was five weeks old; the third child, the two first being girls. Weight at birth 7 pounds 4 ounces. He has been breast-fed entirely, and gained in weight until three days ago. When he was ten days old his mother noticed he was spitting up some milk immediately after nursing, and since this time he has continued to spit up some milk after each nursing, but had gained in weight steadily until three days ago. His weight at one month was 9 pounds 8 ounces. During the last three days the vomiting has increased until he seemed to get rid of the whole feeding, and for the past twenty-four hours the vomiting has been almost constant and no milk has been retained. The stools had been normal until this time. There has been no temperature. On examination the baby is bright and healthy looking. The abdominal picture is striking. The upper abdomen, especially the left quadrant, is distended; while the lower abdomen on both sides is distinctly retracted. No mass can be made out in any part of the abdomen, but in the upper left quadrant a definite globular structure can be rolled beneath the fingers, suggesting a distended stomach. On watching the abdomen for some minutes a peristaltic wave can be seen, beginning under the left costal margin and passing over toward the liver. This is accompanied by projectile vomiting. A diagnosis of pyloric stenosis was made and operation advised, but was refused by the parents.

July 23, 1910.—Various methods of feeding have been tried in the past two weeks with no improvement and progressive loss of weight. The parents have consented to operation.

Operation on July 23, 1910. Ether. Incision was made in the median line, below the navel. A greatly dilated stomach presented. The pylorus was found to be represented by an olive-shaped tumor, $2 \times 2\frac{1}{2}$ Cm. It had a sort of translucent appearance, with a suggestion of green, and projected distinctly beyond the stomach and duodenum. It had a hard and cartilaginous feeling, and no suggestion of a lumen could be made out because of its incompressibility. A posterior, no-loop gastro-enterostomy was done with the aid of two clamps. This presented no especial difficulty except the small size of the intestine. The abdomen was closed.

For the first few days there was some vomiting, which was relieved by stomach washing. He made a good recovery. He has progressed steadily since operation, his weight at two months being 10 pounds 6 ounces; at seven months, 16 pounds; at sixteen months, 22 pounds 4 ounces; and at the present time, three years and six months of age, his weight is 35 pounds.

CASE II.—P. D., male. Born April 12, 1911. He was the seventh child, and his mother died of infection at the time of his birth. His weight at birth was 8 pounds 8 ounces. He took his food well during the first week, but lost four ounces, regurgitating part of each feeding. During the second week the vomit-

ing became more pronounced and loss in weight was continuous. Food was retained for an hour or so, and then ejected with great force, being thrown a distance of several feet. At other times vomiting occurred immediately after feeding. Sometimes two or three feedings would be retained, and then the whole amount would be expelled, the amount ejected appearing greater than the amount taken in. He was always hungry, but bright, and never refused food. The stools and urine were both scant. Pyloric stenosis was suggested by the Sister in charge of the ward.

May 28, 1911.—The baby was examined for the first time. He is bright, but extremely emaciated, weighing 5 pounds 6 ounces. The upper abdomen is distended, the lower retracted. On taking food a wave of peristalsis running from left to right, resembling a ball, can be distinctly seen in the region of the stomach. No tumor can be palpated. A diagnosis of pyloric stenosis was made.

Operation on June 1, 1911. Ether. Median incision. The stomach was enlarged. The pylorus was represented by a hard, whitish, olive-shaped tumor, about $1\frac{1}{2} \times 2\frac{1}{2}$ Cm. The pylorus was stony-hard, and seemed completely obstructed. Posteriorly a no-loop gastro-enterostomy was done with the aid of clamps. The operation was not difficult, except for the great thinness of the small intestine. The abdomen was closed.

The baby was not shocked by the operation. He did not vomit, and feeding was started almost immediately. He gained eight ounces in weight in the first six days. On July 11, six weeks after the operation, his weight was 9 pounds. Since this time the boy has progressed steadily, and, although living in poor surroundings, without medical care or supervision, he is now, at the age of two years and eight months, in excellent health, and weighs 30 pounds.

CASE III.—M. L. B., male. Born March 8, 1913. The fourth child. Healthy. At birth weighed 7 pounds 12 ounces. He was breast-fed, and flourished until three and a half weeks of age, when he weighed 9 pounds. He then vomited for the first time in life, without assignable cause (April 1, 1913). His vomiting continued from this time, and by April 10th the bowel movements had become reduced to a little green mucus. On April 11th his weight had been reduced to 8 pounds and the vomiting had become projectile. April 18th he was seen by Dr. Donnally, having been brought to him from his home in North Carolina. His weight then was 7 pounds 12 ounces. The upper abdomen was fuller than the lower, and after taking food a mass could be seen in the left epigastrium about the size of a ping-pong ball, which rolled down and toward the right. A doubtful tumor was felt in the right epigastrium. A diagnosis of pyloric stenosis was made by Dr. Donnally, and he was referred to me for operation.

Operation on April 21, 1913. Ether. Median incision. The stomach appeared slightly distended. The pylorus was represented by a stony-hard, olive-shaped, grayish-colored tumor, about $2\frac{1}{2}$ Cm. long, projecting distinctly from the level of the stomach. It was incompressible, and apparently completely obstructed. A posterior, no-loop gastro-enterostomy was done with the aid of a clamp on the stomach side only, the intestine being so small and collapsed that no clamp was used. The child stood the operation well and was not shocked. His progress after operation was steady, and he immediately began to gain in weight. On August 15th, at five months of age, his mother writes that the baby is in good condition and weighs 15 pounds 5 ounces. On November 18, 1913, at eight months, he weighed 17 pounds 10 ounces, and was in splendid health.

INTESTINAL SHORT-CIRCUIT, WITH REPORT OF CASES *

BY GEORGE S. FOSTER, M.D.

Surgeon and Pathologist to the Hospital Notre Dame de Sourdes, Manchester,
N. H.

SHORT-CIRCUITING the large bowel, a rather new departure in surgery, opens up a great field for diagnosis and surgical treatment. That grand man of London, Sir William Arbuthnot Lane, was the pioneer in this method of treating certain diseases of the human body.

It is with no idea of originality that I bring this subject forward at this time, but rather to perpetuate certain ideas which I picked up at Guy's Hospital while studying with Sir William. In his clinic one cannot help but be attentive every moment, since the theories brought forward and the excellent results of the large amount of surgery of the intestines at once impress the seeker for knowledge.

Sir William avers that general surgery to-day is, for the most part, dealing with end-results. He believes that gall-stones, thyroid disease, ovarian cysts, tuberculosis (especially that involving intra-abdominal structures), and rheumatic tendencies are the direct end-results of auto-intoxication, and that many other conditions, such as breast changes, might be brought into this category.

The writer had the pleasure of seeing many cases in Sir William's clinic at Guy's from the time of entry to the time of discharge. The extensive changes in the human economy as a result of short-circuit or colectomy were, to say the least, wonderful. The general appearance of improved health was marked. Nodular and chronically inflamed breasts would soften, the prominent thyroid would atrophy, and the haemoglobin count would rapidly increase after these operations.

Sir William has a technic of his own which must be carefully

* Read before the Manchester Medical Society, January 9, 1914.

studied in detail. To me this seems the all-important part, for the secret lies in following along each step systematically. Therefore, upon returning home, I resolved to sift out those cases of auto-intoxication which came under my care and urge them to be treated along these surgical lines. Some of these cases will herein be reported.

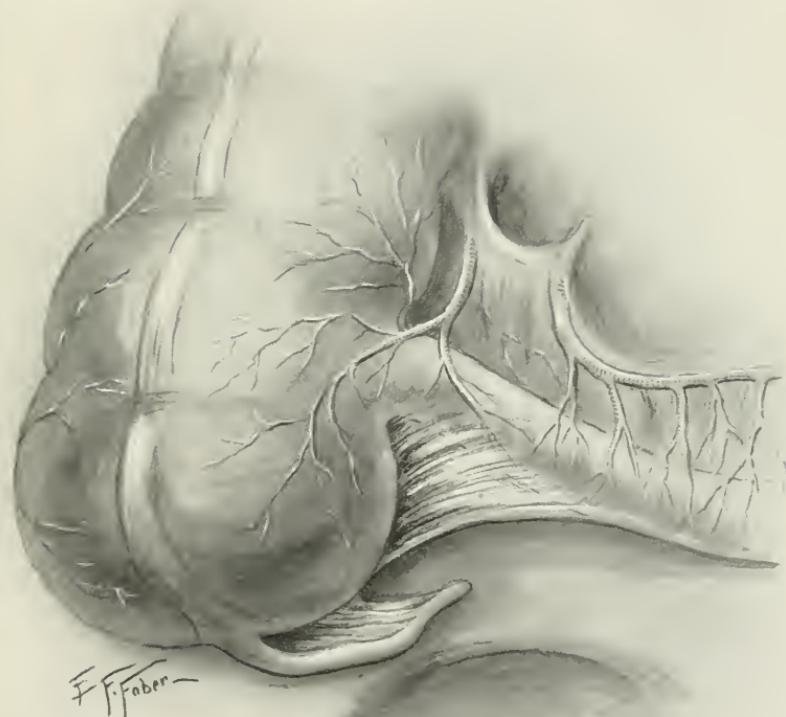
About five years ago Metchnikoff brought forward a theory that the large bowel was only a sewerage and not at all necessary for perfect health. In fact, he even went so far as to state that we would all live longer and enjoy far better health if five feet, more or less, of the colon were removed. It is along the lines of this theory that Sir William has carried out the practical side of the cases. In the place of giving the lactic acid bacillus or the *Bacillus bulgaricus* to counteract the fermentative and pathogenic organisms which make their home in the colon, it has been found far better to do a short-circuit or colectomy.

Combe, in his work on "Intestinal Auto-intoxication," as translated by States, defines this condition as follows: "Auto-intoxication is a toxæmia caused by substances which are formed through the influence of the vital processes of the organism." Thus it is seen that the toxins must be produced within the body, unaided by the introduction of additional organisms from without.

Assuming that our entire alimentary tract was in perfect working order, we might justifiably believe that we could care for these adulterating materials. On the other hand, how many of those suffering as a result of this toxæmia have the small or large bowel kinked, twisted, and interfered with by adhesions! How many of us daily see women who are enteroptotic, with the stomach and the small and large bowel dragged down into the lower abdomen or even into the pelvis! The result is, we are dealing with a person who is not caring for the food products of which she partakes, and fermentative conditions are found all along the alimentary tract.

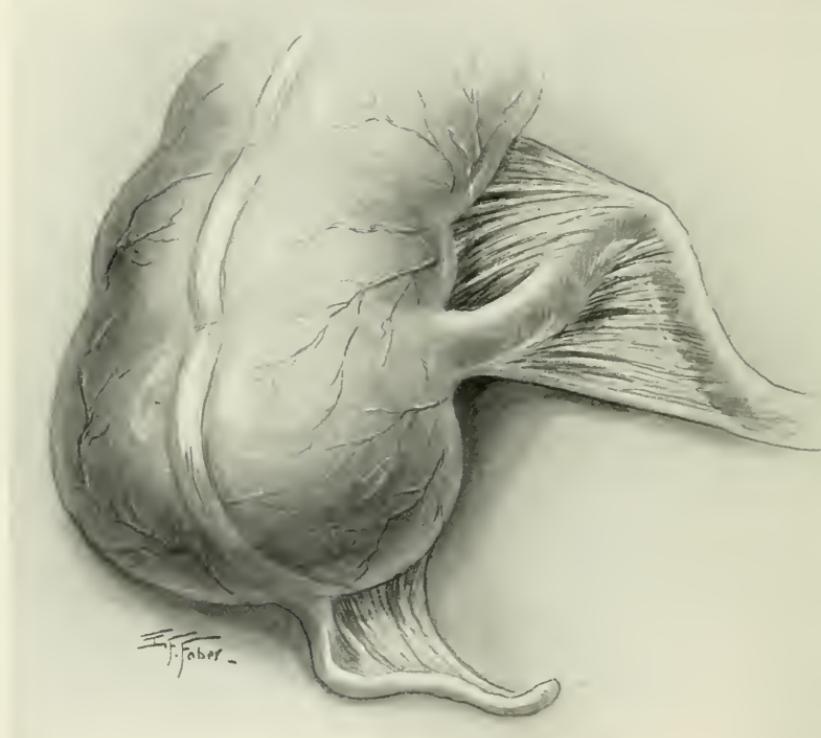
This auto-intoxication may be a first principle through fermentative changes as a result of improper food, insufficient mastication, and ignorance or neglect of the first laws of health and hygiene. As a result we find the person losing weight and the various organs undergoing granular or other microscopical changes. Following this the loss of intra-abdominal fat has allowed the large and small

FIG. 1.



Showing normal angle at which the ileum joins the cæcum.

FIG. 2.



Showing a typical Lane's kink of the ileum. Note the adhesions between the cæcal wall and the ileum and between the two facing surfaces of the ileal wall.

bowel to fall in a conglomerated mass in the lower abdomen or pelvis; the kidneys slip down because of lack of proper support, and the stomach drags upon its support. We find the mesentery, great and gastrocolic omentum, small or gastrohepatic and gastrosplenic omentum supporting these structures to a greater degree than is their normal strength. They become thickened, and the blood-vessels are increased in numbers. When we have such an increase in blood supply we must look for one of two things, namely: (1) An increase in the soft structures already present; (2) additional new structural formation.

As a direct result of this dragging, pulling, and increased blood supply adhesions spring forth. We find these adhesions involving various coils of the small intestines. Later these new formations contract, and we find kinks at various points along the ileum. Sir William has so thoroughly described these kinks that the principal ones along the lower eighteen inches of the ileum now bear his name.

Given a person with the type of abdominal cavity described above, we will also find that the ascending colon, hepatic and splenic flexures and sigmoid are encased by a complete covering of new membrane. These are simply adhesions so carefully moulded about the large bowel that they form a covering rather than producing kinks. Sir William has christened these formations acquired adhesions. Stiles of Edinburgh has stated that these last-mentioned adhesions are always present at birth. He does not believe in the acquirement theory of Lane. However, majority rules, and for the present it would seem that Lane's theory is more nearly correct. As a result of these adhesions of the small bowel the kinks which form render effective peristalsis and segmentation incomplete, and even stagnation would seem to be present at times. The acquired adhesions about the colon mean that that organ must carry an extra burden, and, unless the musculature is proportionately increased, impairment of proper function is the result. Therefore we are confronted with improper bowel activity throughout its entire length. The result is an overworked stomach, fermentation within the large and small bowel (particularly in the lower end of the ileum and all of the colon). Abnormal gases and other products are produced, and these, not being properly passed on, are absorbed and auto-

intoxication results. Thus we are dealing with a vicious cycle or endless chain. Systemic diseases, as tubercles, thyroid disease, etc., can produce loss of weight, resulting in the adhesive stage, and auto-intoxication or improper living may so affect the intestinal tract as to allow the formation of adhesions and kinks.

Adhesions give us two forces to consider: traction and countertraction. Wherever we find force exerted in one direction causing kinks, we must, of necessity, have some resistance in the opposite direction, so that we have this continual pulling and dragging accompanied by resistance. The immediate result is improper muscular activity of the alimentary tract, or, stating it in a different way, an atypical functional activity lessened to a marked degree. Because of this interference normal health is impaired and we find extraneous influences creeping in: the tubercle finds good food and a nook for development; the ductless glands cannot act as they should; the lymphatic system becomes overtaxed, resulting in hyperplasia; the heart, kidneys, and liver undergo cellular and muscle-fibre changes. These are all, as a rule, end-results and not causes. Conceding this to be true, why is the intestinal short-circuit or colectomy not a practical surgical problem? I feel sure that many of the conditions outlined above are, to a greater or less degree, fully abated or ameliorated by this procedure. I also feel that more of this sort of surgery will be done in the future.

I desire to report five cases in which I have performed this operation, with most pleasing results in four of the cases, the fifth case having a markedly contracted or infantile descending colon and sigmoid. The physical symptoms are entirely relieved, and the condition requires more time for the relief of certain mental strains.

CASE REPORTS

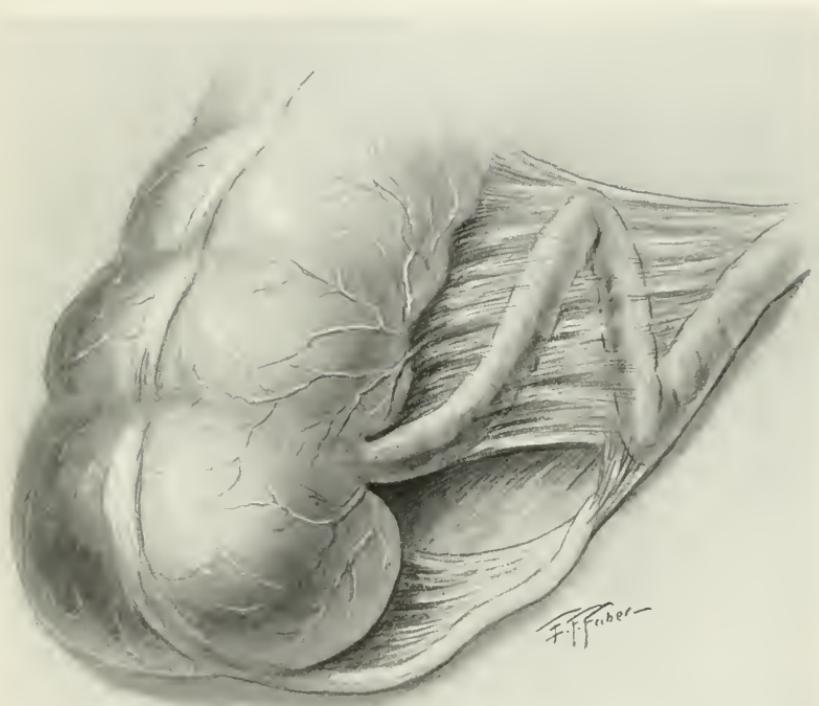
CASE I.—Mrs. R. Age 53.

Family History.—Not important.

Patient's History.—Unimportant. Has always been well and strong; never been pregnant; menstruation regular and normal.

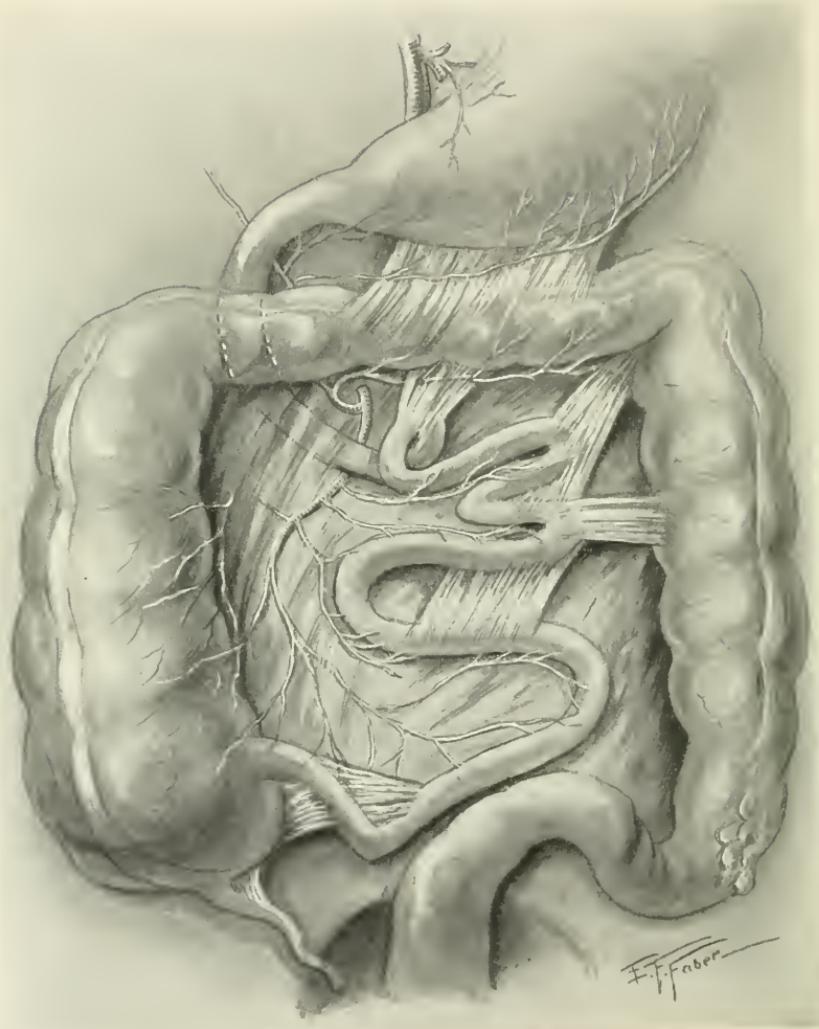
Physical Indications.—Two years ago began to have pain, which was most marked under scapula in right shoulder. This pain was intermittent, gnawing in character. About this same time she became very nervous and was what she termed "threatened with nervous prostration." About one year ago she began to have interference with normal function of fingers, arms, and legs. She could not sew as well as before, and could not walk as well. During the past year she has gradually grown worse in all these symptoms, and has resorted to

FIG. 3.



Showing a typical double Lane's kink of the ileum resulting in ileal stasis. Note the atrophy of the ileum as a result of partial disuse. The appendix is purposely overdrawn to fully typify the elongated, hyperplastic appendix so often seen in this type of cases. The end of the appendix is seen adherent to the ileum. The constricted ileum lumen is in evidence.

FIG. 4.



Showing the formation of adhesions between the transverse colon and the greater curvature of the stomach; transverse colon and loop of jejunum; jejunum and splenic flexure; ileum and descending colon and its own sections; ileum and cæcum at the ileoçæcal valve. Pull and counter-pull are well demonstrated, resulting in kink and stasis. Interference with the normal circulation, segmentation, and peristalsis are the result. Associated diseases are the end product.

veronal, trional, alcohol, and even morphine, to help her out of the agony of long, restless nights.

Habits.—Drinks tea and coffee moderately; bowels constipated; appetite poor; sleeps but little; micturition normal.

Physical Examination.—Heart and lungs negative; abdomen, marked tenderness and muscular rigidity over entire right lower quadrant; the stomach and transverse colon were markedly dilated; generative organs negative; no glands or ascites; œdema of the ankles quite marked; feet and hands cold; over the scapulae, posterior surface of the upper arms, and about the chest varied cold areas were felt by palpation; urine negative; blood, hæmoglobin 90 per cent., white blood-corpuses 7000, red blood-corpuses 4,000,000; differential count normal; radiographs of the affected shoulder showed nothing abnormal; any attempt at passive motion of the arms and legs caused rigidity and muscular spasm; active motion very limited; the feet dragged while walking; balance not well kept; reflexes not negative.

Diagnosis.—Auto-intoxication secondary to some colon disturbance. I advised operation for short-circuit; consent was given, and patient entered the Notre Dame Hospital in August.

The usual preparatory treatment was instituted, and on August 16th I performed Lane's short-circuit operation. At this time the appendix was removed; the ileum was separated from the root of the cæcum and the latter closed; the free end of the ileum was then invaginated into the wall of the rectum just below the last kink of the large bowel. The descending colon was found contracted and thickened about the size of the middle finger.

The patient made an uninterrupted recovery, remaining in the hospital four weeks. Since that time she has engaged in long walks, systematic calisthenics, breathing work, bathing, diet, and massage. Some days she had covered five miles; the glow of health has returned to her lips, cheeks, and ears; the eyes are bright, and the cold areas over the body surface, as well as the cold feet and hands, have become warm; the bowels are regular, the appetite is very good, and she sleeps about twice what she could previously, but some mental symptoms are yet present.

CASE II.—Miss M. Age 13. Occupation, student in public schools.

Family History.—Grandparents, both maternal and paternal, died of tuberculosis.

Patient's History.—She had never been well and strong, and could not play and run like others of her age. She has not menstruated as yet.

Physical Indications.—For the past two years she has had intermittent diarrhoea and a marked cough, but night-sweats were not noticed. She has lost about ten pounds in weight the past six months. Diarrhoea and cramps in bowels were more marked for the past three months. Her habits were good, with no tea or coffee, but her appetite was poor; she slept fairly well, but dreamed a great deal.

Physical Examination.—Poorly developed and nourished. Heart and lungs were negative; abdomen flat and flaccid; tenderness and muscular rigidity over lower right quadrant; stomach and colon not markedly dilated; no glands or ascites; reflexes negative; urine negative; blood, hæmoglobin 70 per cent., white blood-corpuses 8000, red blood-corpuses 3,000,000; temperature, 101°.

Diagnosis.—Tubercles within abdominal cavity.

I advised operation, and consent was given.

On September 17, 1913, an operation at Notre Dame Hospital was performed, when the appendix was removed and Lane's short-circuit operation done. Tubercles were found studding the ileum and colon, and the glands about the root of the cæcum were palpable, hard, and in groups.

The patient made an uninterrupted recovery, remaining at the hospital four weeks. Since her operation she has gained ten pounds in weight and her color has markedly improved. Her cough has disappeared, and she walks five or six miles daily. She has returned to school and resumed her studies with much vigor.

CASE III.—Mrs. B. Age 26. Married. Occupation, housewife.

Family History.—Maternal grandmother, great-grandmother, and several aunts and uncles died of tuberculosis.

Patient's History.—Unimportant. She has never been pregnant and always menstruated regularly.

Physical Indications.—For past year she has had intermittent diarrhoea and has lost considerable weight, although she cannot state figures. Her strength seemed to be leaving her, and her appetite was poor. She slept fairly well and her micturition was normal, with no cough or night-sweats.

Physical Examination.—Poorly developed and nourished. Mucous membrane pale; sallow complexion, with dark arcs beneath lower lids. Heart and lungs negative; abdomen flat and flaccid, with tenderness and muscular rigidity over entire surface; stomach and entire colon dilated; no glands or ascites; generative organs negative; urine negative; blood, haemoglobin 75 per cent., white blood-corpuses 7200, red blood-corpuses 3,800,000; temperature over period of one week, morning average, 97.8°; afternoon average, 100°.

Diagnosis.—Tubercles within abdominal cavity.

On October 1, 1913, the patient entered the Notre Dame Hospital, and two days later I performed Lane's short-circuit operation, finding tubercles and glands, and removing the appendix at the same time. She made a rapid recovery and remained in the hospital four weeks. Since the operation she has gained 14 pounds. Her general appearance as to color, complexion, and muscular tone has improved almost beyond belief. She now walks five or six miles daily, and enjoys perfect normal functions. The bowels are regular, and there is no suggestion of looseness, while the temperature, both morning and afternoon, is normal.

CASE IV.—Miss T. Age 19. Single. Shoe operator.

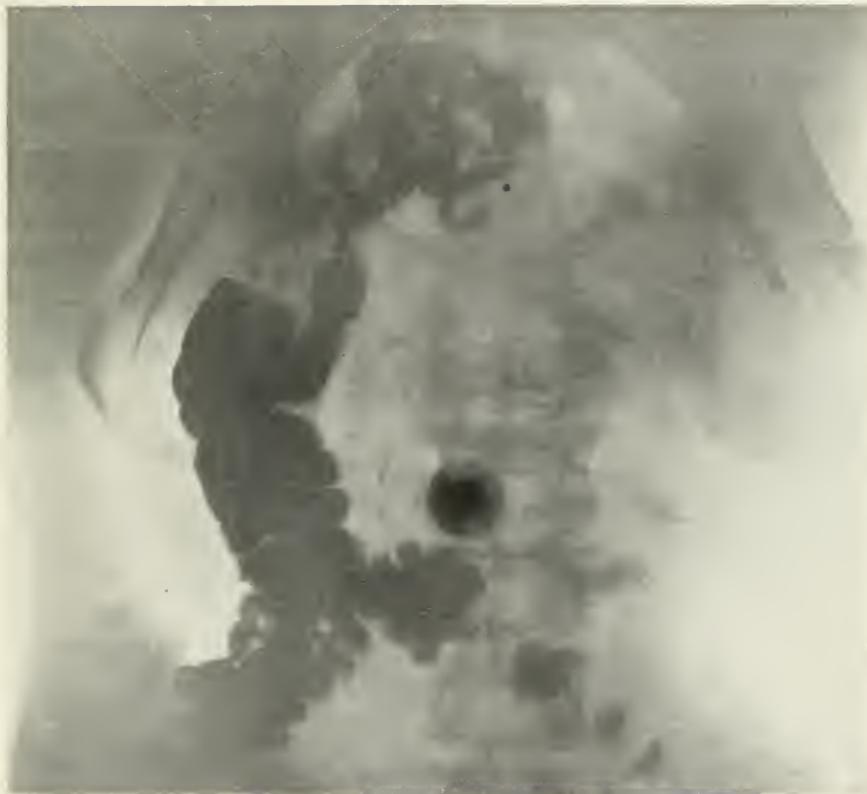
Family History.—Unimportant.

Patient's History.—Unimportant. She menstruated at 13 years, and has always been regular.

Physical Indications.—For the past nine months she has felt soreness in the left lower quadrant of abdomen. This soreness would be more marked some days than others. She had no vomiting or nausea, but coughed a good deal, which was more marked in the morning. She raised some thick, yellowish material at times. Occasionally she had diarrhoea for a few days. This would disappear and remain quiescent for a week or two at a time. Her appetite was poor and she did not sleep well. Micturition was normal. She was accustomed to drink both tea and coffee.

Physical Examination.—Fairly well developed and nourished. Mucous membranes pale; she had a staring gaze; heart negative; lungs, harsh breathing at

FIG. 5.



Bismuth in ileum 24 hours after meal. Note the angle at which the ileum meets the cæcum. The flaccidity of the ileal wall is very marked.

left apex, no râles; abdomen rounded and fairly firm and resistant; tenderness and muscular rigidity over lower right quadrant; stomach and transverse colon dilated; no glands or ascites; reflexes negative; urine negative; blood, hæmoglobin 80 per cent., white blood-corpuses 4000, red blood-corpuses 3,000,000; differential count normal; temperature, 98°; hands and feet cold; cold areas over shoulder, posterior surface of upper arms, and chest.

Diagnosis.—Auto-intoxication. Tubercles (?).

I advised operation, and on October 30, 1913, she was operated upon by me at the Notre Dame Hospital. The appendix was removed and Lane's short-circuit operation done. A few glands were felt about the root of the caecum, but these were not extremely hard. She made a good recovery, and is now walking two or three miles daily. Her weight is slowly increasing, and her general appearance has altered noticeably for the better. The previously cold skin areas and hands and feet are now warm. The cough has disappeared, and the roughened area in the lung has nearly cleared up.

TECHNIC OF OPERATION

The *modus operandi* from the time the patient enters the hospital until discharge is as follows: The patient enters the hospital two days previous to the time set for operation. Immediately she is put to bed and the bowels cleaned out by divisional doses of the mild chloride of mercury, followed by an ounce of castor oil in orange juice. It is always customary in these cases to make a complete blood analysis upon entering, and we adhere to this rule very closely. She is given liquid diet and large draughts of water up to midnight the night previous to the operation, while the water is continued up to within one hour of the operation. The morning following entry a high suds enema, two quarts in amount, is given. This is again repeated in the evening, when another ounce of castor oil in orange juice is given. The following morning another high suds enema of the same amount as previously is given. A half hour before the operation she is given a hypodermic of morphia, gr. $\frac{1}{4}$, and scopolamine, gr. $1/100$. The field of operation is prepared as for any laparotomy. We prefer to merely suds the skin well, shave well down over the pubes, rinse off with sterile water, and then resuds. This last suds is rinsed off with sterile water, followed with $1/2000$ bichloride solution and again sterile water. The skin is then rubbed dry with a sterile towel and a dry, sterile gauze dressing applied.

In the operating room, after the patient is anæsthetized, the axillary apparatus is put into play. This is a most important part of the procedure, for by this method the patient is allowed

to drink saline by the loose tissue of the axillæ during the entire operation. Anywhere from 70 to 140 ounces of the saline are used on average cases, so that shock and post-ethereal vomiting are thus eliminated.

The abdominal dressing is then removed and a very wide field painted with tincture of iodine. A median incision of extra length is made, extending from the umbilicus to the crest of the pubes. This long incision is necessary for good work, as there is much to be done and clear observation is needed for its accomplishment. Before the peritoneum is incised the skin edges, muscle, and fascia are protected by moist gauze held in place by Bachause clips, so that any opportunity for unnecessary contact of the intestines with the skin is avoided. The peritoneum is then incised and the ileocæcal angle sought and lifted out of the opening. The appendix is removed by the usual slab suture method. The acquired adhesions about the lower end of the ileum and root of the cæcum are teased free and these parts brought well out, for the operation is always a flat failure unless this is done, as acquired adhesions must be separated for success. The mesentery anchoring the lower two or three inches of the ileum is then perforated by blunt forceps and tied off both approximal and distal to the gut. In doing this it is always best to avoid including any large vessels. Following the formation of this opening, the contents of the ileum, in this section, are milked away and the part clamped near the valve and again at a point one-half inch distant. All subsoil and adjacent structures are then covered with moist gauze and the ileum separated from the cæcum by actual cautery. The stumps are then carefully wiped off with small gauze sweeps and further cauterized to the point of complete desiccation. They are then carefully bathed with 70 per cent. alcohol. The moist gauze wall is next removed and the ileal stump wrapped in a fresh, moist gauze and rolled up away from the angle. The short distal ileal stump is then treated with a purse-string linen suture and invaginated into the cæcum. This is superimposed by a second purse-string linen suture for exactness. The cæcum is then dropped back into its original bed after a bath with 70 per cent. aleohol.

Next the rectum is sought at a point three inches below the last kink. This is brought out of the wound, the contents milked away for some distance in each direetion, and this area is then clamped

in such a manner that the free band forms the summit, running parallel with the forceps, for this is essential, as will be seen later, for the rectum is opened through this band. The free end of the ileum is then uncovered and swung around in such a way that it will point toward the rectum without forming a kink or producing the slightest degree of a twist. All subsoil and adjacent structures are protected by the warm, moist gauze, and an end-to-side anastomosis is done. As previously stated, the opening into the rectum is made through the free band. Three linen sutures are used in completing this anastomosis: the first suture includes the seromuscular coats, the second the serous coat only, while the third takes in all of the coats on both sides. An intermittently lapped suture seems to serve best for protection against structure at this point. After the suturing is completed all walling is removed and the area bathed with 70 per cent. alcohol.

While the anastomotic area is yet held in view a specially-constructed rectal tube, 18 inches in length, is inserted into the rectum through the anus by an assistant, and the free end of this tube is connected with a valved rubber bulb and liquid paraffin is gently pumped into the bowel as the tube is pushed along. Generally eight to twelve ounces of the paraffin are used. As the end of the tube reaches the anastomosis it is guided through the new opening and allowed to enter the ileum for about six inches. At this time four to six ounces more of paraffin are injected and the intestines allowed to drop into their new bed with the tube *in situ*. Next the external surface of the wall of the colon at a point just above the last kink is sutured to the left pelvic wall by a single linen suture. This produces an exaggerated kink, thus preventing regurgitation beyond this point. This last move is of vital importance if we are to be successful. The abdominal wound is then closed in the usual way.

A hot gauze and cotton boric acid compress is then placed over the entire abdomen, superimposed by oiled silk, and the usual binder applied. The rectal tube is clamped at the visible end and also sutured to the lower angle of the vaginal vulva to prevent slipping. In males it is sutured to the perineum.

Postoperatively the immediate treatment covers a seven-day period. The head of the bed is elevated one and half feet, as in modified Fowler's position. The clamp is removed from the tube

and allowed to drain on gauze pads. The hot boric acid fomentations are changed every four hours for seven days. Water by mouth, hot or cold, is begun after six hours, and increased in amount very rapidly, as seldom any vomiting follows.

The following morning liquid paraffin is begun, being given by mouth one ounce three times a day. For seven days nothing but water and paraffin are given. Seldom are any hypodermics given, as pain is absent and the circulation good. On the sixth day the tube is withdrawn, and the following day the fomentations are omitted, a day dressing applied to the abdomen, and feeding begun in the usual manner. The head of the bed is also lowered at this time. Seldom does the temperature go beyond the 100° mark, and oftener it is at 99° or below.

A SIMPLE AND SUCCESSFUL MEASURE FOR TREATING THE PERFORATION OF A GASTRIC OR DUODENAL ULCER

BY EDRED M. CORNER, M.C., F.R.C.S. (ENG.)

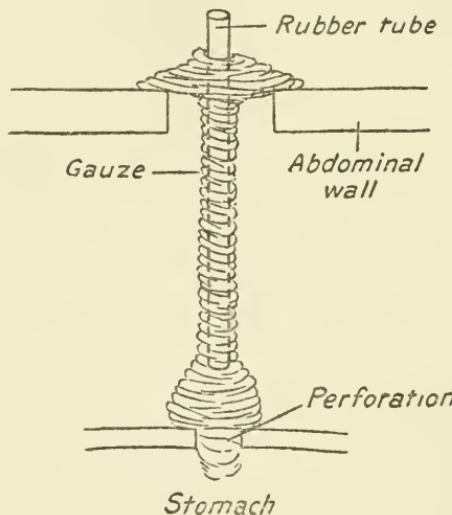
Surgeon and Lecturer to St. Thomas's Hospital, London, and to the Children's Hospital, Great Ormond Street, London

ABOUT a year ago, in a paper contributed to the Surgical Section of the Royal Society of Medicine of London upon the results of operation for the perforation of a gastric ulcer, I mentioned a method of dealing with the perforation by tamponade. This can be done without any time being spent in attempting to close the perforation by suture. The method is of easy application, and can quickly and simply be used by those less experienced in surgery, a very important point nowadays as so many men practise the art of surgery. Thus it is within easy attainment of the comparatively inexperienced surgeon attached to a minor provincial hospital. Most doctors may be suddenly called upon to operate for the perforation of a gastric ulcer, as, with the perverseness of things in general, the perforations will not occur when a skilled surgeon is about; whilst it is wrong to wait the arrival of such a man and so jeopardize the patient's chance of recovery.

In 1912 I received a warning from Boston, in Lincolnshire, to hold myself in readiness to depart on a sudden journey there. Later in the day I was asked to come, and arrived in the late afternoon. The patient was a young man, recently married, who had suffered from his "stomach" for some years. About four years ago a gastro-enterostomy had been done by Sir Berkeley Moynihan, of Leeds. This had relieved him for a time. Then came a sudden attack of pain and great collapse. I saw him within 24 hours of the perforation. The abdomen was tightly distended with extravasated gas. There was no liver or any other abdominal dulness. To be short, there was no doubt of the diagnosis. But no operation was allowed by the friends until the surgeon arrived from London. When I arrived the poor man scarcely had any pulse at the wrist!

Still, within 24 hours of the perforation so young a man could not be allowed to die without an effort being made to prevent it. So a hurried operation was done while the patient was infused. It seems almost needless to add that the patient died after rallying for a time. After the operation one of the doctors who was so kind as to have assisted me said: "Were not the patient's chances of life lessened by the delay in operation? Would not a less perfect operation which was not delayed be preferable to a more perfect but delayed operation?" Undoubtedly the delay had greatly lessened

Fig. 1.



Gauze plug for treating the perforation of a gastric or duodenal ulcer.

the patient's chances of recovery. And I must answer the second question by showing that a comparatively simple operation is all that is necessary to enable such a patient to live. Also, I must thank my professional colleague for his courtesy in referring to my work as a "more perfect but delayed operation." Indeed, I hope to show in this paper that there is no need to use the adjectives less perfect and more perfect in connection with an operation for the perforation of a gastric ulcer.

Such an operation must be carried out quickly, and may be done in the manner now to be briefly described. (1) Open the abdomen below the umbilicus. Examine the appendix and the pelvic

viscera. Place a gauze packing in each loin and in the pelvis and leave them there. (2) Open the abdomen above the umbilicus,—*e.g.*, through the inner part of the right rectus. Find the perforation, mop out any extravasation above and below the liver. Place one end of a tube which leads out of the wound (Fig. 1). (3) Partially close wounds after removing the gauze, draining the pelvis if there is much extravasation.

In the convalescence do not withhold morphine, but do not use it heedlessly. Withhold liquids by mouth except in ounce doses. A patient on "rectal saline" is in no great want of food by mouth. In 48 hours the drains or "plugs" are removed under an anaesthetic and replaced in part. A gastro-enterostomy is not often needed, and no time is wasted in closing the perforation by suture. So frequently is the tissue round an ulcer too soft to hold stitches that, unless the ulcer can be excised, it is better not to attempt to close the perforation. It is very doubtful how long such stitching lasts, and, though apparently secure at the operation, it may be loose 10 minutes later. Therefore, there should always be a drain to the site of the perforation.

In my communication I mentioned that this proceeding had been done many times. Since that date I have done it several times more, proving its efficiency. Two instances only will I quote, because they impressed themselves on me by being done in one night and because they bear on the theoretical suggestion that the non-suture of a perforation must lead to the formation of a gastric fistula. This, I may say, hardly ever occurs, and, when it does, is only temporary.

One Tuesday afternoon I was called to see a lady whose doctor had diagnosed the perforation of a gastric ulcer. When I saw her there was nothing except a history of "neuralgic dyspepsia" and tenderness in the epigastric region to suggest that the abdominal calamity originated in the upper abdomen. All the physical signs,—distention, rigidity, dulness, immobility, etc.,—were in the lower abdomen. On opening the peritoneal cavity nothing was found in the lower abdomen. Later a perforation was found by the lesser curvature on the anterior wall of the stomach. The perforation was large, surrounded by a sodden area of inflamed tissue, and much fluid was issuing from it. The perforation was tamponed in the

way described above. Forty-eight hours after the operation the "gastric" gauze was changed, when gas and fluid escaped from the stomach. The issuing fluid smelt like gastric juice, and was more copious when fluid was taken by mouth. It was only mildly septic and interfered little with the healing of the wound. This fistula was present for about ten days, when it healed spontaneously. Returning, as I opened the front door of my house the telephone rang from Colney Hatch Asylum, where a nurse was suffering from the perforation of a gastric ulcer. In her case the diagnosis was simple. The operation was also simple, and was carried out as narrated above. The perforation was much smaller than in the lady just mentioned. Her recovery was very prompt. Her indigestion vanished and her general health has improved. In neither case was a gastro-enterostomy necessary at the time or has proved to be so later. Indeed, I suspect that, in the absence of (narrowing the stomach by) suture, a gastro-enterostomy is less often required than if the perforation is sutured.

These two instances are specially selected only because they happened to take place on the same night, and by preventing my getting to bed stamped themselves as possible examples of results of tamponading the ulcer. Its advantages I will briefly summarize: (1) The operation is simpler for the operator to do. (2) The operation is quicker, particularly in less experienced hands. (3) In consequence of being simpler and quicker the patient more easily gets over it; that is to say, the mortality is lower. It certainly is so amongst my own figures. (4) A gastro-enterostomy, primary (at the time of the operation for the perforation) or secondary (at a later period), is less frequently required. (5) Complications,—*e.g.*, pelvic abscess, subdiaphragmatic abscess, etc.,—are in my experience less frequent.

If such a summary is in its turn summarized, it may be said that such an operation offers the patient more chance of success, particularly in the hands of an operator of no great experience. Of course, in the hands of experienced and facile operators the excision of the ulcer, followed by suture of the wound and, perhaps, gastro-enterostomy, may be better and result in the recovery of the patient; but for more ordinary patients, surgeons, and circumstances the method of tamponade is better.

TREATMENT OF TUBERCULOUS HIP-JOINT DISEASE WITH COEXISTING SINUS BY MEANS OF BISMUTH PASTE—REPORT OF CASES *

BY EMIL G. BECK, M.D.

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To realize what strides have been made in the treatment of surgical tuberculosis, one must review the medical literature of the past century. The treatment varied according to the views held of the nature of the disease at different periods. Before the era of Pasteur's discoveries the mortality of surgical treatment was most frightful, and surgeons, discouraged, hesitated to operate. According to Follin's figures, the mortality at that time in operations of hip or spinal caries was 56 to 70 per cent. A step forward was made by Lannelongue in France and Koenig in Germany when the study of pathology and asepsis were initiated. With the aid of these they advanced a new form of treatment. We may call this the "daring period." They advocated the radical resection of the entire tuberculous area. This logical practice was no doubt adaptable to smaller foci of disease, but when attempted in the hip or spine exposed the patient to an enormous risk. This radical treatment naturally also produced a large mortality, and, when the patient recovered, he usually remained a cripple. It did not take long before this method also lost its popularity and all its defenders. Less radical methods then came into vogue, and now, after many years of diligent study, work, and discussions, the surgeons are up to a certain point practically agreed on a certain form of treatment for surgical tuberculosis.

First of all, they try to diagnose the condition early.

Secondly, they try to check the extent of the disease by immobilization of the diseased joints; they place the patients in the best hygienic surroundings, feed them with the most nutritious food, keep them outdoors in the sunshine; some use the vaccine, and often add

* Read before the Western Surgical Association, December 19, 1913.

tonics to support the patient's general health. Up to this point it seems most surgeons agree, but from this stage on differences of opinion exist. If, in spite of all precautions and the very best of scientific treatment, the case progresses and abscesses form, what should be the proper procedure? This is the vital question.

The surgeon who will give the correct answer to this question will save many lives and reduce the big army of cripples.

It is a sad commentary, but it must be spoken, that too many physicians still believe that a fluctuating cold abscess should be opened and drained by a rubber tube.

How can we put our words into language strong enough to impress upon them all that this procedure is more dangerous than most any disregard for surgical asepsis. Calot says: "The physician who opens a cold abscess and drains it with a tube opens the door through which death nearly always enters." It would be really a wonder if "secondary" infection would not take place. This secondary infection may not kill every patient, it may be mild enough not even to cause a high degree of fever, but, as a rule, it will cause a persistent sinus and a chronic and distressing suppuration. Thus it is considered a grave error to open and drain a cold abscess. What, then, should be the proper procedure? Should we wait until it ruptures spontaneously? No!

It should be treated by either puncture with trocar, allowing some of the fluid to escape and inject a modifying substance (Calot's mixture or formalin), or by small incision and injection of bismuth paste. I have used in the past six years bismuth paste (10 parts of bismuth subnitrate and 90 per cent. of yellow vaseline) for this purpose, and shall speak of this in the latter part of this paper. All these methods are fully described in text-books, and the results reported are most gratifying, providing the technic is properly carried out. If, in spite of all precautions, a secondary infection should take place and a chronic suppuration should persist, then I recommend the injection of 30 per cent. bismuth paste, and to this part of the treatment I shall devote the larger part of my paper.

It is now about eight years since the bismuth treatment of sinuses was introduced into surgery. From time to time I have reported the progress made in its application, in order that others may become better acquainted with the technic, its limitations and dangers. The

method has from the start found many adherents, and has been tried not only in hospitals and clinics here and abroad, but has been used most extensively by country practitioners. Reports from these sources have already accumulated in the literature, so that at the present time one may draw conclusions from them.

Some authors have obtained better results than we have, others have been only partially successful, and in the hands of a few the method has been a failure. If we take into account, however, that we deal with a class of cases which have already been treated by other methods, surgical and otherwise, without success, we must regard even the smallest percentages of cures an actual gain. The analysis of reports from all sources, however, indicates that on the average more than 50 per cent. of these apparently hopeless cases were finally cured by these injections. At one time it received a serious setback by reports of cases of fatal bismuth poisoning, which, fortunately, at present occurs very rarely, considering that the method is now used more extensively than ever. The prompt reports of these cases of poisoning, and several papers which I published for the purpose of its prevention, seem to have been effective in checking further occurrence of this complication, inasmuch as only one case has been reported since 1912.

Many of you have no doubt had experience of your own in treating sinuses resulting from empyema or joint affections with these bismuth injections, and are familiar with the method from the literature. This relieves me in a degree of the necessity of discussing the theoretical side of this subject, and permits my time to be devoted to the practical side.

I have decided to report here only on one type of this class of cases, and have intentionally chosen the tuberculous hip-joint disease because it is the type which is the most unfavorable to treatment, which has the largest mortality, and in which naturally the percentage of cures was the smallest.

Most of the cases of hip-joint disease which come to us for treatment are those which years ago had passed through the acute stage, developed abscesses which, as a rule, had been drained and secondarily infected. You are familiar with such cases. They constitute the worst scum of surgical refuse, cases in which every sect of medicine and surgery, and even quackery, has had a chance. Two of these

cases in our series had lasted forty years, and several had had from 10 to 15 surgical operations.

Such surgical residuum is not a very inviting field for any one, and I am sure that a discriminating surgeon will not envy me for this class of material; nevertheless, out of these apparently hopeless subjects, I am able to exhibit many satisfactory results. My purpose, however, does not consist in showing you what results I personally can obtain with this method. You are, after all, interested only in what you yourselves might accomplish, and therefore, instead of citing percentages of cures, I shall select from the series of 102 hip-joint tuberculosis cases thus far treated only such cases as will suggest new points in the treatment and aid you in applying the method effectively. The histories of the entire series will be reserved for a future publication in connection with a complete report of all varieties of cases treated.

The bismuth paste has been employed for diagnostic and for therapeutic purposes, as well as for the treatment of cold abscesses.

(a) *For diagnostic purposes.*

Its usefulness for diagnostic purposes has been acknowledged by all who have employed it. Medical literature from all parts of the world contains records of hundreds of cases in which this method cleared up puzzling conditions. To illustrate, I cite two cases which were supposed to have been hip-joint disease, but which, in fact, were sacral tuberculosis.

CASE 39.—Tuberculosis of the Sacrum Mistaken for Hip-joint Disease. Treated and Operated as Such.

Wm. E. E., twenty-five years old, single, was treated for rheumatism of the hip from 1902 to 1904. In 1904 he suddenly had a pain in his right groin, and a few days later a swelling appeared underneath Poupart's ligament. Two months later this was incised, pus evacuated, and a rubber tube 14 inches long was inserted. Following this he became very much emaciated; chills and fever persisted. For two years his disease was considered to be hip-joint disease, because a contracture of the adductors and an impaired motion of the joint misled the doctor, and no radiograph had been taken at that time. An operation was performed which aggravated the condition, and six months later another operation was performed with no other results than adding another sinus above the posterior part of the crest of the ileum. Altogether four sinuses resulted, which kept on suppurating constantly. He came to me in 1910, and the injection of these sinuses cleared up the mistake in diagnosis; namely, that this was not a hip-joint disease, but a tuberculosis of the sacrum (see Fig. 1). The injections of bismuth were continued for three years. While his general health has im-

FIG. 1.

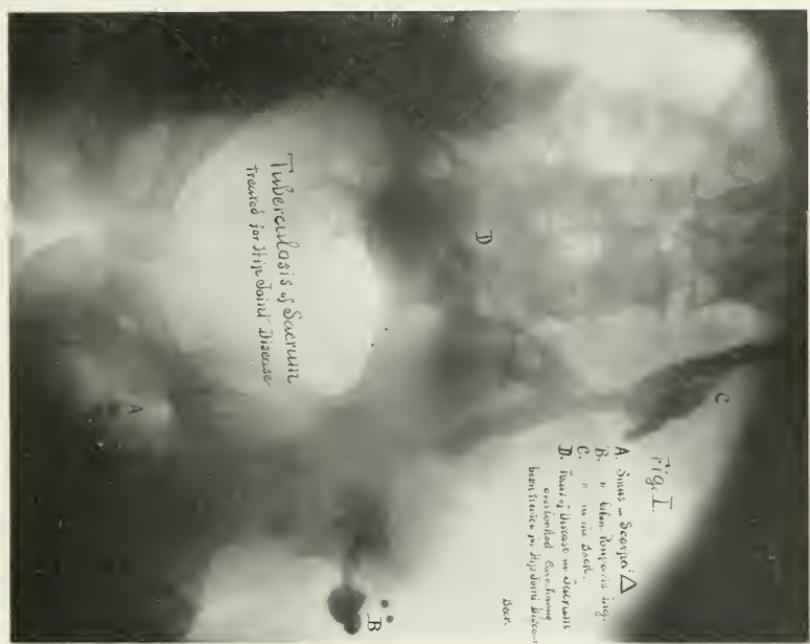


FIG. 2.



Tuberculosis of sacrum treated for hip-joint disease. A, sinus in Sacrum's triangle; B, sinus below Poupart's ligament; C, sinus in the back; D, focus of disease in sacrum overlooked, base having been treated for hip-joint disease.

Sacral tuberculosis disclosed with injection of bismuth pasto. Note channel from hip to sacrum. A, B, C, openings of sinuses; D, sacral focus.

FIG. 3.



FIG. 4.

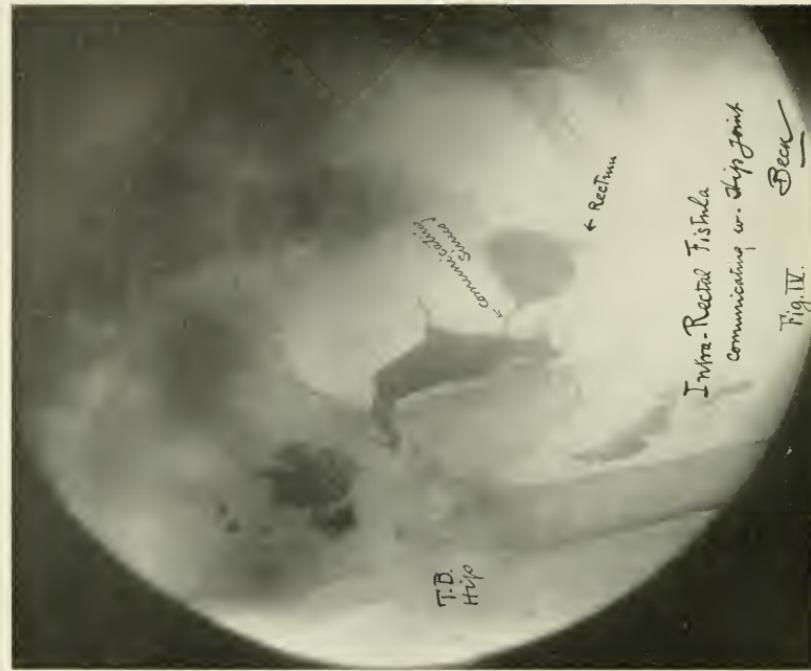


Fig. III.

Fig. IV.

Intra-rectal fistula communicating with hip-joint.

Sacral tuberculosis causing sinus and abscess near hip. Discharging sinus & abscess. Injection of bismuth paste disclosed focus of disease. Closure after first injection.

proved and his weight increased, the sinuses persisted in discharging about the same quantity of pus. A sequestrum was localized in the promontory of the sacrum, and I decided to remove it. This was done three months ago, and upon the removal of the sequestrum all four sinuses closed. Unfortunately, two months later he developed an abscess in the lumbar region on the other side, which I opened only ten days ago and removed another sequestrum from the sacro-iliac joint on the left side. The final outcome is problematical.

CASE 100.—F. F., age twenty-three, had an attack, supposed to be rheumatism in the sacral region; had high temperature and was confined to his bed for six weeks. He was then apparently well until the fall of 1912, when the hip on the left side became double the size of that of the right. Osteopathic treatment was applied, and later the hip was lanced by the osteopath in the region of the upper gluteal region and a discharging sinus persisted. Three months later two abscesses formed on the posterior aspect of his thigh, which were operated upon, and thus two sinuses were added. Bismuth injections were used by his physician without any results. He came to me in November, 1913, for examination. An injection into the sinuses cleared up the diagnosis. Instead of the suspected hip-joint disease, it proved to be a sacro-iliac tuberculosis, as our illustration (Fig. 2) clearly shows.

Examples like this explain to a degree why surgical operations for these chronic suppurating sinuses often fail. A glance at the radiograph which represents injected sinuses teaches us how irrational it is to attempt a dissection of tortuous sinuses which lead into an inaccessible region. In the light of these pictures the probing of a sinus will not appeal to those who wish to be consistent.

THERAPEUTIC PURPOSES

At the present time very few doubt the therapeutic effect of the bismuth paste in old chronic sinuses and empyema. In our own series of 1100 cases treated at the North Chicago Hospital we have used the paste in practically every variety of chronic suppurations, such as sinuses resulting from spondylitis, hip-joint disease, tuberculous knee, ankle, shoulder, wrist, and ribs; osteomyelitis in all parts of the osseous system, including the clavicle and fibula, which are extremely rare; further, in chronic suppurations of soft structures, such as sinuses after extirpation of kidney, broken-down tuberculous glands, rectal fistulæ, and sinuses following laparotomies. The accessory sinuses of the head and the fistulæ of the alveolar process have also been treated by this method. Only fistulæ of the gall-bladder, the pancreas, and those communicating with the cranial cavity have, for obvious reasons, not been treated.

It is quite difficult to obtain statistics as to the extent of the use

of this method and the various surgical conditions in which it has been applied, because the bulk of the cases come into the care of the general practitioner in the country, who treats them in his office or the patient's home, and thus only a small fraction of treated cases find their way into literature. Up to 1913 the following have made reports:

Name	No. of cases	Percentage of cures
Ochsner, Chicago	20 tubercular sinus	55
Ridlon and Blanchard	17 tubercular sinus	53
Beck, E. G., Chicago	192 collective report	64
Robitschek, Minneapolis	9 tubercular sinus	55
Don (Edinburgh)	— tubercular sinus	17
Rosenbach, Berlin	4 tubercular sinus	50
Dollinger, Budapest	16 tubercular sinus	12½
Beck, J. C., Chicago	319 accessory sinuses	22
Pennington, Chicago	17 rectal fistulæ	76
Baer, Baltimore	12 tubercular sinus	33½
Stern, Cleveland	4 tubercular sinus	100
Steinman, München	5 tubercular sinus	20
Bogardus, U. S. A.	1 tubercular sinus	100
Vidakovich, Russia	2 empyema	100
Nemanoff, St. Petersburg	6 empyema	100
Ochsner, A. J., Chicago	14 empyema	85
Beck, E. G., Chicago	11 empyema	82
Ely, New York	14 tubercular sinus	43
Hines, Cincinnati	9 tubercular sinus	89
Cuthbertson, Chicago	1 intestinal fistula	100
Sandor, Sag., Budapest	2 otologii	100
Heitz, Boyer, Morens, Paris	11 renal sinuses	73
Zollings, Zürich	25 tubercular sinus	54
Schober, Philadelphia	5 tubercular sinus	80
Gessner, New Orleans	4 tubercular sinus	50
Schmid, Vienna	15 tubercular sinus	30
Rivera, Porto Rico	8 tubercular sinus	75
Goror, E., Paris	3 tubercular empyema	66
Reichfelder, Washington	4 tubercular empyema	75
Brandes, Kiel	29 all varieties of sinuses	76
Beck, R., Chicago	58 alveolar sinuses	54
Beck, R., Chicago	9 empyema antrum	66
Collective reports from 19 dental surgeons in U. S. A.	39 alveolar sinuses	74
Collective reports from 19 dental surgeons in U. S. A.	4 empyema antrum	100

We note that the results are not the same in the hands of the different reporters. I believe I can explain the reason for the un-

equal results. During my visits to various hospitals in America and Europe I have had the chance to observe why some men have failed. I shall name some of the reasons.

My brothers and I have treated a group of cases in which the bismuth paste had been applied by others without success. This furnished the opportunity to study the causes of failure in a variety of most instructive cases. In some the cause of failure could not be explained. A case often healed after our first injection, whereas the same patient had been treated elsewhere by the same method without success. We could not tell whether faulty technic, unsuitable instruments, or improper material was responsible for the failure.

In other cases the causes of failure were quite apparent. Aside from the most common cause, namely, the presence of a sequestrum, we found foreign bodies. In one case, for example a metal probe in the humerus; in another, a rubber tubing within the medullary canal of the humerus, accidentally left in years before; then two rubber tubes within an old drained empyema cavity, etc. These were causes which had prevented the paste from obliterating the suppuration. As soon as these foreign bodies were removed, the cure was almost spontaneous.

The most common cause, however, is the faulty technic and insufficient knowledge of the rules which have been laid down for the treatment. "How often do you inject?" I am asked very frequently. The answer to this question is: "As often as you have failed to reach the focus of the disease."

We must remember that a sinus or fistula is nothing more than a shrivelled abscess or abscesses. It leads from its opening on the skin or bowel to the place where the disease originated, and this focus of disease is often at a considerable distance from the opening or openings of the sinus. It is, therefore, inconsistent to try to eradicate the suppuration by only dissecting the sinus tracts. With the radiographic reproductions of the labyrinths of sinuses before us, an attempt to dissect the same borders on the ridiculous.

To find the root of the trouble and to eradicate it is the only rational method to pursue. If you find the focus from which the sinus originated, and disinfect it, in practically all instances the sinuses will close up. It is, therefore, essential that, when a fistula or sinus is injected with bismuth paste, the paste must reach the

focus of the disease. If, through faulty technic this is not accomplished, one cannot expect results. The first injection ought, therefore, produce the desired result. If it does not, then we must assume that the paste has not found its way into all portions of the diseased tract, and we must try it again. It is a safe rule to wait at least one week. If the discharge changes its character from a purulent to serous, and the microscopic examinations of a slide and culture show that the secretion is sterile, we should not reinject: the sinus will usually close within a very short period. If, however, the discharge continues to be purulent, and we find micro-organisms in it, then we should reinject at least two times a week.

Most of these points were brought out with the evolution of this treatment, and through application of one method to a large series of one class of cases. The hip-joint disease offers a greater opportunity for illustration than any other, and I wish to relate what we have learned from treating a series of 102 consecutive cases.

We have made the following general observations:

First.—We have found that hip-joint disease, in its incipient stage, is too frequently diagnosed as rheumatism. Two-thirds of our cases gave the history of having been treated in the beginning for rheumatism or sciatica.

Second.—We have further noted that, when the disease had progressed to the stage of abscess formation, incision and drainage were, as a rule, employed, a method which, of course, is now generally condemned.

Third.—We noted, also, that sacral tuberculosis or that of the sacro-iliac joint is frequently taken for hip-joint disease. We have met with five such cases. The reason for this mistake is explained by the similarity of the swelling and contracture of the limb on the affected side, which we find in hip-joint cases. The radiogram in such cases is a deciding factor. This aid had been used in only two of these five cases previous to our examinations, and in these the pictures were not clear enough to make their interpretation possible. Two such cases I have cited under the head of diagnosis, and here I cite another example.

Tuberculosis of Sacrum Mistaken and Treated for Hip-joint Disease.

R. K., thirteen years old, with tuberculous family history, was well until the age of five, when a swelling in his left hip, posterior to the greater

trochanter, appeared. An abscess ruptured spontaneously and a copious purulent discharge persisted for seven years, which greatly debilitated the boy. In July, 1908, he was given the first injection of bismuth paste by Dr. Dahl, with whom I treated the case. The radiograph (Fig. 3) disclosed the fact that the abscess did not originate in the hip-joint, as one would suspect from the location of the sinus, but that it communicated with the original focus in the sacrum by a narrow channel. This case proved to be not only an interesting example of the diagnostic value of the bismuth paste, but it likewise credited the therapeutic account with a cure of which both the doctor and patient are justly proud.

Fourth.—Another rather rare complication occurred in four of our cases; namely, that the hip-joint disease produced a rectal fistula. I illustrate all four cases, but give only short histories of each. These belong, of course, to the most severe type of joint destruction in which the abscess has spread along the path of the fascia, usually through the notch below the anterior superior spine, then along the pelvic fascia toward the pararectal tissues, and there either opened into the rectum or around the anal opening.

CASE 12.—Hip-joint Disease Causing Intrarectal Fistulae.

T. S., a young lady, seventeen years old, developed a typical hip-joint disease two years previously. After extensive destruction of the joint and shortening, two abscesses formed and one opened above Poupart's ligament, the other on the anterior aspect of the thigh. She complained also of intrapelvic pain, constipation, and pain during urination. An examination of the rectum revealed an abscess high up in the rectum. Compressing the abscess would cause the escape of pus through both sinuses in her groin. The stereoradiogram of the bismuth paste (Fig. 4) gives a very graphic picture of the abscess formation in the vicinity of the rectum. The abscess ruptured spontaneously into the rectum about three weeks later, and resulted in an intrarectal fistula. The final result in this case was a complete cure, of the rectal sinus as well as the hip sinuses, and, aside from the shortening of the limb and impairment of motion, the patient is entirely well.

CASE 50.—Hip-joint Disease and Spinal Tuberculosis Causing Rectal and Anal Fistulae.

I. B., thirty-six years old, developed hip-joint and spinal tuberculosis at the age of nine years. After a number of years of conservative treatment, abscesses formed around both hips and lumbar region. Several of these were incised and some opened spontaneously, so that at the age of twenty she had ten discharging sinuses about the hips and back. During the next ten years she had undergone a number of surgical operations, none of which was of any avail. At the age of twenty-eight she joined the Christian Scientists, and became a most devoted disciple of that cult, receiving their constant treatment for eight years. I saw her first in 1909; then she could not walk, but could manage to get out of her very low bed to urinate about every half hour, on account of a chronic cystitis.

The cystitis was the result of a perforation of a sinus into the bladder.

One sinus perforated into the rectum and another about one inch from the anal opening. Here, then, we have a combination of a hip and spinal tuberculosis causing a rectal as well as a vesical fistula—a most distressing combination (Fig. 5). The bismuth treatment had the effect of closing both the rectal as well as the urinary fistulae, but several of the other sinuses continued to discharge. The patient was soon able to be up and walk for blocks, and resumed her worship at the nearest Christian Science church. In all sincerity she attributed her improvement to her faith in Christian Science. In order not to hurt my feelings, she declared that I myself was a Christian Scientist, but was not aware of the fact. The final result I could not trace.

CASE 58.—Hip-joint Disease Causing Anal Fistula.

E. D., aged eleven years, five months ago had a severe chill, fever, and a severe pain in the hip for three weeks. Abscess formed and ruptured one week later. Another abscess opened between the scrotum and anus ten days later. These kept on discharging profusely until he came to me in October, 1911. He was in an emaciated condition, hardly able to turn in bed, weighing only fifty-three pounds. The accompanying illustration, the radiogram of the injected sinuses (Fig. 6), gives more information than any description. This represents a very acute form of tubercular and mixed infection, which, as a rule, is fatal. This case, however, improved upon the very first injection. He gained in weight at the rate of three pounds a week, and to-day he walks, but has a slight discharge from the fistula.

CASE 64.—Hip-joint Disease Causing Rectal and Anal Fistula.

Young man, twenty-eight years old, developed, at the age of eight, a hip-joint disease with an extensive destruction of hip-joint, consequent abscesses about the hip and one near the anal opening. For the past twenty years six sinuses kept on discharging profusely. I saw him first in 1911. He had a shortening of the left leg of four inches, and all six sinuses discharged so profusely that it required two dressings each day in order to preserve any semblance of cleanliness. Repeated injections of bismuth paste produced considerable improvement; two sinuses closed, but the remaining four continued to discharge moderate quantities of green pus.

In May, 1913, he developed another painful abscess near the rectum. I incised and injected the same, and found the network of sinuses and their communication with the hip-joint as shown in radiogram (Fig. 7). Since the last injection the patient gained fourteen pounds, but four sinuses still remain open. He reports that from time to time small pieces of bone are eliminated from the sinuses.

The following case represents a more uncommon complication:

CASE 40.—Tuberculous Spondylitis with Sixteen Urinary Fistulae.

J. G., age twenty-five, suffered, at age of seven, with pain in his right knee. A year later an abscess formed over the great trochanter, and shortly after more abscesses formed around the whole pelvis, all of which opened, and the final result was twelve sinuses, all of them discharging pus mixed with urine.

For the last seven years not a drop of urine was passed through the urethra. In 1906 Dr. Steele, of St. Louis, curetted several of these sinuses. New abscesses formed, so that when he was referred to me he had sixteen urinary sinuses, his

FIG. 5.



Fig. V. Hip-Joint disease causing Rectal-Vesical Fistula.

FIG. 6.



Fig. VI.
Anal Fistula.
from Hip-Joint Disease.
Beck.

Hip-joint disease causing rectal and vesical fistula.

Anal fistula from hip-joint disease.

FIG. 7.



Hip-joint disease. Sinuses produced rectal and anal fistulas

FIG. 8.



Tuberculous hip with sixteen urinary sinuses injected with bismuth paste.

right leg was flexed, and his hip ankylosed. The entire pelvic region was in an acute eczematous condition from the constant saturation of urine and pus.

I injected all fistula at once with a 33 per cent. bismuth vaseline paste, and two hours later the patient passed, for the first time in seven years, his urine through the natural channel. The urine, however, contained a large percentage of pus and some of the paste.

The radiogram (Fig. 8) exhibits a veritable labyrinth of sinuses. The sinuses began to close rapidly and eczema was markedly improved, but a new trouble started: the patient developed a severe cystitis, which required frequent irrigation of his bladder. Within two weeks eight sinuses were closed, the others markedly improved, and only one discharged a few drops of urine. In this condition he left my care and returned to St. Louis. The final outcome is not known to me.

Another unusual case is the following:

CASE 46.—Hip-joint Disease Requiring Removal of the Entire Femur.

A. V., thirty-two years old. His illness dates back twelve years. Started with a severe pain in his right knee. In this case hip-joint disease was at once diagnosed and limb immobilized. Six months later he had to submit to an operation on his hip, and to another six months later, and all wounds healed primary. For five years all seemed well, when all at once abscesses appeared around the hip, and this time the head of the femur and its upper one-fourth was removed. The resulting sinuses would not heal, in spite of persistent treatment, for five years, and thus another operation for the removal of the entire femur down to the condyles was performed. All healed nicely except a small fistula in the groin. In November, 1908, he was first examined by me, and I found that, although the entire femur from the condyles upward was absent, there was not so marked a shortening as in other similar cases. The limb could be flexed on itself in the centre of the thigh to right angle. Although he was told that his limb would be useless without bony support, he would not permit its amputation, his reason being that some day surgery might be so advanced as to be able to supplant a bone and make the limb useful. The radiogram (Fig. 9) illustrates the condition present. The two parallel narrow strips running upward are regenerated strips of bone where some periosteum had been retained in the muscular channel after removing the femur. The sinus leads into the cavity of the acetabulum. I have been unable to close this little fistula, and for this reason hesitate to advise the transplantation of a femur until we succeed in closing the sinus.

Fifth.—The acetabulum and ileum: how often is it affected?

The acetabulum is affected in the majority of hip-joint cases. Rarely does it break through into the pelvis and allow the abscess to find its way into the pelvis, but it does happen sometimes. We have one such case on record (see report of four cases of rectal fistula). The iliac bone is affected in about 5 per cent. of the cases.

I cite here a case in which the larger portion of the iliac bone was destroyed.

CASE 90.—Miss M., sixteen years old, developed hip-joint disease at the age of six. The process of destruction was so extensive and rapid that it destroyed the entire head of the femur and soon involved the entire ischium of the pelvic bone. The destruction of the latter bone was so extensive that after a few years there was only the central part of that bone left. The outer margin of the iliac bone for about $1\frac{1}{2}$ inches was destroyed, leaving only a ragged edge on its circumference. An abscess formed about six months after the incipient trouble; three sinuses resulted after the rupture and incision of same. There was a persistent discharge for nearly ten years, the girl could not walk without crutches, and was in an emaciated condition. In April, 1913, the sinuses were injected, and proved that they all communicated and that within the acetabulum was a small cavity, indicating that sequestra must be present (Fig. 10). I removed these sequestra by curetting through one of the sinuses, and subsequent injections produced a closure of all sinuses within a month. The girl gained rapidly in weight and is able to walk without crutches.

A case remarkable from many points of view is the following:

CASE 81.—*Hip-joint Disease with Coexisting Pulmonary Tuberculosis.*

F. B., seventeen years old, was taken with pulmonary tuberculosis when fifteen years old. The affection was quite acute and caused a rapid decline in her health. To this was added a hip-joint disease. For one year the hip was put in a cast and she was placed in the most favorable surroundings to restore her health, and was in charge of the best medical counsel. In spite of all this an abscess formed and was allowed to rupture spontaneously. Secondary infection took place, and all that she had gained during the past year was lost, her weight having fallen from 125 pounds to 89 pounds. In this condition she was brought for treatment. The tuberculosis of her lung was still present, but from her description it was somewhat improved.

There were two sinuses about three inches apart, both in line of the Poupart's ligament. These sinuses discharged about two ounces of green pus every twenty-four hours. The injection of the paste and the radiograph (Fig. 11) disclosed a most interesting condition; namely, that these two sinus openings, while very near to one another, led into two different directions. One led to a coil of sinuses within the pelvis underneath the iliac fascia, while the other led into an abscess along the fascia lata. This demonstrated to us that, no matter how near together two openings of sinuses are, they do not necessarily communicate.

In the absence of the radiographic guide one would be tempted to unite these two openings when operating, which, of course, would be entirely wrong.

The therapeutic result in this case was most unusual. The pus discharge changed into a serous within twenty-four hours, and from this time on the patient gained at the rate of from four to eleven and one-half pounds each week, until she had gained forty-eight pounds

FIG. 9.



FIG. 10.



Hip-joint disease with removal of femur. Regeneration of bone from retained periosteum.

Hip-joint disease with destruction of iliac bone. Three sinuses (A, B, C), ten years. Closure in three months.

FIG. 11.



FIG. 12.



Two sinuses, both originating from hip-joint, but not communicating. Sinus A extends into pelvic cavity; sinus B is external, gravitating along fascia lata.

Hip-joint disease with destruction of head of femur and with descending abscess. Ten per cent. bismuth paste injection (closure).

within two months. Both sinuses closed, and, what was more remarkable, she had lost all signs of her pulmonary tuberculosis. Last November, two years after closure of sinuses, I invited her to appear before the Surgical Congress in Chicago, and, to my surprise, she came with her husband, having married in the meantime. This case is instructive for many reasons:

First.—It is rare that active pulmonary disease coexists with bony tuberculosis. In my experience of about 450 cases of tuberculous joint diseases, I remember but three cases in which I could find an extensive coexisting, active, pulmonary affection. I have found evidence of a healed-out tuberculosis of the lung in some of the cases by taking stereoscopic radiograms of their chests, but the active type is rare. In fact, tuberculosis of joints seems to protect one against the pulmonary. Why did the pulmonary tuberculosis cease when the local condition in the hip was cured? This is a large subject and I cannot go into it in this paper, but I have sufficient data, clinical as well as experimental, to offer an explanation, which I shall report in the near future.

These cases cited are, of course, the more unusual types. The bulk of the hip-joint cases where they have reached the point of sinus formation have one to five inches shortening, a tipped pelvis, and three to four sinuses. The openings are usually distributed as follows: one just below Poupart's ligament internal to the iliac vessels, another along the external border of the gluteus maximus, and a third just below the greater trochanter. Once in a while another sinus opens near the sacro-iliac synchondrosis.

We have noted that after the joint was closed in a patient who for years could not carry his weight on the diseased limb, on account of the acute pain in the joint, and who was obliged to use crutches, he could walk without pain, and we have in most instances allowed the patients to discard the crutches. In 1909 I showed at the North Side branch of the Chicago Medical Society four such children in whom I had recently closed suppurating sinuses and allowed them to walk without crutches. I maintain that after several years' standing the tuberculous focus had been extinguished and that the secondary infection was all that affected the child. In none of these four cases has there been any recurrence since 1909.

THE PREVENTION OF SINUSES

This procedure consists in the opening of cold abscesses and injecting them at once with a 10 per cent. bismuth paste, without suturing the opening or introducing a drain (see Fig. 12). The quantity used depends upon the size of the abscess, but should not exceed 100 grammes, because in these fresh abscess walls absorption of bismuth is apt to take place more rapidly and cause bismuth poisoning.

We have treated with this method 110 cases, of which three are of the hip, and have made the following observations:

(a) That in practically all cases we could prevent a secondary infection.

(b) That the creamy pus upon opening the abscess was changed into a straw-colored fluid within three or four days after injection.

(c) That 90 per cent. of all cases thus treated closed within three weeks after incision and injection.

The preference to the bismuth over other modifying substances was given for the following reasons:

1. The paste is injected through a small incision instead of using a trocar, and thus the possibility of missing the abscess is eliminated.

2. By discarding the aspirating needle the danger of injuring underlying vital structures is avoided.

3. Through an incision it is possible to evacuate the larger clumps of the tuberculous *débris*, which could not pass through the aspirating needle.

4. The thick paste within the cavity will allow the escape of secretions along the walls of the abscess, but secondary infection is prevented.

5. Injections of other modifying fluids must, as a rule, be repeated, while with the paste the first injection usually attains the desired result.

6. The injection of bismuth paste is neither painful nor irritating. It is injected in a warm, semi-liquid state, and remains long enough in contact with the diseased tissues to produce its therapeutic effect. The vehicle (vaseline) does not macerate the walls of the abscess. Toxic effects from bismuth subnitrate can easily be prevented.

DANGERS AND COMPLICATIONS

The only danger which has been advanced is the possibility of bismuth poisoning. My brothers and myself are fortunate in not having had a single fatal case in our series of 1100 cases. I met with the symptoms in one case of empyema treated during the infancy of this treatment, and was able to check the progress and save the patient. This case was reported by me in the *Journal of the American Medical Association*, January 8, 1909, and is the first case on record. I then warned the profession against the indiscriminate use of the paste. It is fortunate that most of these accidents were at once reported in the literature; this has put on guard those who thought that bismuth was an entirely harmless substance. It must have had a very salutary effect, because nearly all the cases of poisoning occurred in the first two years, 1908 and 1909.

It is gratifying to know that the poisoning can be prevented, and if it accidentally occurs and is discovered, it can be checked before it causes irreparable damage.

PREVENTION OF BISMUTH POISONING

The prevention consists of not allowing large quantities of the paste to remain in the body for absorption. Should the symptoms appear, the paste must be removed by washing out the cavity with warm olive oil. The sterile oil is injected and retained from twelve to twenty-four hours, in order to produce an emulsion, which should be withdrawn by means of suction. After its removal all symptoms will promptly disappear. Scraping out the paste with a scoop is a dangerous procedure, because it opens fresh channels for absorption.

The following case illustrates the prevention of bismuth poisoning:

R. W., aged thirty-three, fell from a horse at the age of fifteen, injuring his left hip. Three months later an abscess developed, which ruptured spontaneously. Within a year the limb shortened four and one-half inches, and five sinuses about the hip developed and persisted in discharging pus the next seventeen years. In the fall of 1908 the bismuth injections were begun at his home. The first few injections were made by his physician, and thereafter (he living in a rural district) the treatment had to be continued at home by the patient's wife. She "faithfully" injected every day, and after thirty days he developed typical signs of bismuth absorption; namely, blue ulcers of the gums,

headache, loss of weight, etc. The radiograph demonstrates that enormous quantities of paste have accumulated in pelvic cavities, with no outlet for their return, and thus their absorption.

The sinuses were immediately washed out with warm olive oil, and within twenty-four hours nearly all the paste was withdrawn by means of a suction pump. Symptoms of bismuth poisoning subsided within four days, but the sinuses continued to discharge. Four weeks later I injected 30 grammes of paste. The secretion changed from that of pus to serum, and two weeks later the sinuses closed.

In conclusion, I wish to say that, after we have perfected this method to its highest degree, there will still remain some cases which will not yield to this or any other treatment, and our aim should therefore be directed to the prevention rather than the cure of this most disastrous condition, the destruction of the hip by tuberculosis.

THE SURGICAL TREATMENT OF GALL-STONES: THE INADVISABILITY OF UNDERTAKING SURGICAL OPERATIONS WITHOUT THE CONSENT OF THE PATIENT *

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WHILE the field of biliary surgery is not new, as surgery goes, it is comparatively recent as regards actual time. Early in my professional career surgical intervention for the relief of biliary calculi was rare and in these rare instances in which surgery was invoked exploration extended no farther than the gall-bladder! At that time it was deemed advisable to do a "two-stage" operation: the viscera was stitched to the peritoneum at the first sitting, then incised and evacuated of its contents three or four days later after firm attachments had formed, the general cavity being thus securely isolated. With the development of bacteriology and asepsis, and a fuller appreciation of Listerian principles, the operation was completed in one stage; but the technic was imperfect, in that the gall-bladder was stitched to the fascia, which frequently produced painful conditions, oftentimes a permanent fistula.

As a result of the classical work of Naunyn upon the cause and pathology of gall-stones, and the studies of Riedel, Mayo Robson, Brockbank, Mayo, Deaver, Richardson, *et al.*, the development of surgical resources for the permanent cure of biliary disease was rapid, and has now been well-nigh perfected. But, has the last word been said?

It has always seemed to me that the diagnosis of disease and a thorough appreciation of the pathology actually and potentially present are of far greater importance than the purely mechanical part of surgery. The latter may be perfected upon the lower animals or cadavers, but to elicit histories which are of value, to correlate and adjust symptomatology and clinical findings, requires painstaking study, keen observation, and an ability to interpret and analyze ascertained facts which

* Clinical lecture delivered at the Louisville City Hospital before the senior class of the University of Louisville, Medical Department.

can be acquired only by extensive observation in the sick-room, at the operating table, and at necropsy; and alongside of operative skill and dexterity must be placed surgical judgment, difficult and sometimes impossible of acquirement, something which cannot be taught, which largely depends upon temperament, and is, in a measure, inherent in the individual.

The pathology of gall-bladder disease as presented on the operating table may be, and not infrequently is, so extensive as to baffle the most experienced, calling for quick decision, extreme patience, and laborious work, and requiring an after-treatment so different from the ordinary routine that the least error in management—just as an error in the selection of certain cases demanding postponement of operative intervention—may result most disastrously.

That operations for calculi of the choledochus tract are always easy, the most satisfactory to surgeon and patient, or the safest in the entire domain of abdominal surgery, are statements often made, which, while applicable to the majority of a certain class of cases (though not all), are subject to much modification in many instances, and to absolute contradiction in some! From a considerable experience I am free to say that some of the most difficult, complicated, and dangerous operations, the outcome of which has not always been entirely satisfactory to either myself, the patient, or the family, have been those undertaken for the relief of biliary disease.

As a basis for these remarks the notes of our last 100 cases of cholecystostomy and other operations upon the bile-passages during the same period have been used, and for the purpose of discussion these may be divided into five groups:

- (1) Cholecystitis with or without calculi, including the acute, suppurating, and gangrenous types.
- (2) Stone in the gall-bladder without cystic duct or common duct obstruction, and with no acute infection.
- (3) Cystic duct calculus obstruction with or without stone in the gall-bladder, and without acute cholecystitis.
- (4) Common duct obstruction with or without stone in the cystic duct or in the gall-bladder.
- (5) Stone in the common duct accompanied by acute hemorrhagic pancreatitis, this being included merely to illustrate one of the sequelæ of biliary calculi.

First.—In acute empyema of the gall-bladder without calculi the cystic duct becomes obstructed as a result of swelling of the mucosa and round-cell infiltration of its walls from bacterial invasion; therefore, the surgical treatment should allow ample time for the subsidence of this inflammation of the interstitial structures. In my experience the unforeseen and unexpected relighting of preexisting infection has occurred in only one instance, though I have observed quite a number of cases of empyema of the gall-bladder with infected walls and impaired circulation, all of which were drained for periods varying from four to ten weeks. The most striking fact in this group has been the low death rate following cholecystostomy, regardless of the condition of the gall-bladder or the nature of its contents. Equally good results have been obtained in badly-infected cases, either with or without calculi—in the presence of localized peritonitis with plastic exudate—in both the adherent and the free gall-bladder.

While I do not desire to discuss the particular technic of operation in this group of cases, I will state that the best results can be obtained only by (a) the most careful attention to detail, by (b) the absolute prevention of peritoneal soiling, by (c) the careful suturing of the gall-bladder, by (d) the proper placing of the biliary drainage tube, and by (e) drainage of the renal and hepatico-duodenal fossa if there be the least suspicion of escape of the gall-bladder contents into the peritoneal cavity. The rule, "When in doubt drain," must here be adopted. We must never lose sight of the fact that we are close to the large lymph-spaces of the diaphragm, and that absorption takes place in the upper abdomen too rapidly for the peritoneum to throw out a protective wall of lymph and isolate the area.

I have never found it necessary completely to remove the gall-bladder either for gangrene or for acute infection. My practice has been to preserve as much of the viscus as possible after excising the gangrenous areas; *i.e.*, the gall-bladder has been resected to a greater or less extent, the defect closed by Lembert sutures in two rows, the gall-bladder drained, and the area surrounding it drained or protected by coffer-damming with gauze or, better still, with gauze and rubber dam. It is acute infection which invades the wall slowly,—giving Nature time to form protective adhesions of the stomach, duodenum, colon, omentum, etc.,—that causes the patient to return subsequent to operation, complaining of incomplete relief, or even jaundice,

although all stones have been removed. Two such cases were encountered in the series mentioned where secondary operation was necessary for complete relief. While it would seem, from all that has been said and the many papers published, that in gall-bladder infection without stone, or even with calculi, proper drainage would afford the most satisfactory relief to the individual, cases have been observed in which this was not true; and this type is one that may cause subsequent trouble for the surgeon and be far from satisfactory to the patient and the family.

The two cases in which secondary operation was required occurred in prominent citizens of this State. The first case (No. 1337)—and these cases are mentioned not only because they directly bear on the subject, but because frequently more can be learned from the citation of cases than from a merely didactic exposition of a subject—was a prominent member of the bar, a judge of the Supreme Court, who presented a cholelithiasis for which he had been under treatment for five or six years with the mistaken diagnosis of gastritis. And it may be said, *en passant*, that the majority of patients with biliary disease who come to operation have been treated for longer or shorter periods for “digestive disturbances” diagnosed as either dyspepsia, indigestion, gastritis, or by some other meaningless term! I had in mind such diagnoses when speaking of the necessity for careful examination and diagnostic ability. This patient, after his five years of treatment, presented an acute obstruction of the cystic duct, the diagnosis having been made by his family physician of this city, and not by the specialist who had previously had him under treatment for the time stated. The family physician, Doctor Hill, who referred the patient to me, had believed for some time that the Judge had a gall-stone; but, notwithstanding this fact, one of our city specialists had made a diagnosis of gastritis, and had kept him persistently and continuously under treatment for the period mentioned. During the attack of acute obstruction Doctor Hill induced the patient to consult a surgeon, and brought him to me; at this time he presented, as shown by subsequent operation, which verified Doctor Hill’s diagnosis, an acute empyema due to a stone in the cystic duct which obstructed the outflow from the gall-bladder. The stone was removed, drainage was instituted, and, despite the fact that this patient had a very high arterial tension and chronic interstitial nephritis with the usual accompanying symptoms,

he made a complete and satisfactory recovery, being dismissed from the hospital at the end of three weeks. Subsequent to his dismissal there was a recurrence of pain, similar to that from which he had previously suffered, and he developed profound jaundice which lasted for two weeks and necessitated the reopening of his gall-bladder through the old incision, which was done without an anæsthetic. After closure of this incision he had another attack of jaundice, which subsided under active purgation, since which time he has had no further trouble, and it is thought will have none. This is mentioned as one of the cases which may not be from every standpoint satisfactory.

The second case (No. 1359), operated upon about the same time as No. 1337, was a Congressman from this State who presented acute suppurative cholecystitis due to calculus obstruction of the cystic duct. At the operation many soft, irregularly-faceted calculi were removed, and the gall-bladder drained. He remained in the hospital for two weeks, the drainage tube being *in situ* at the time of his dismissal. Recovery was apparently complete, but after returning to Washington he began again to suffer pain, and, although he had previously never had jaundice, he now became icteric, and returned to me about a year after his first operation distinctly yellow, and complaining of painful symptoms similar to those from which he suffered before the operation. A second operation was performed. Numerous adhesions were found about his gall-bladder; these extended to the junction of the cystic and common duct, making traction upon the same, and thus producing obstruction with jaundice. These adhesions were detached, and the bile tract thoroughly palpated, but no further (overlooked) stones were found. A large piece of rubber dam was placed between the biliary tract and the adjacent intestines, and the wound closed. This rubber dam was removed six or eight days later, since which time he has had absolutely no trouble, has passed through an active and successful campaign, and is now busily engaged with his duties in Washington.

In studying these two cases retrospectively I can not see that a different mode of treatment or anything which might have been done would have altered the subsequent history and course, as presented by the clinical pictures. Both were considered light cases, although both presented an active localized peritonitis of recent development around the gall-bladder. In both the general peritoneal cavity was

drained, as is usual in such cases. Neither had any difficulty or disturbance during convalescence, both leaving the hospital in the usual time. That they were perfectly satisfactory to the operator, to the patient, to the family, or to the family physician, I do not believe. And, as stated, a second stay in the hospital, with a major operation upon one and minor operation upon the other, was necessary before entire relief was obtained.

Second.—Of this group it can be truly said that all of the cases were satisfactory in every respect, although even here there may occasionally be unexpected results which do not entirely coincide with our prognostications previous to operation. There have been no cases in this group in which we have been disappointed, nor any in which the patient has not realized all that had been promised; but a condition may well be conceived in which an infection surrounding the gall-bladder might make necessary the extensive stripping of adhesions, and in which, drainage not having been thorough, either angulation of the common duct or subsequent adhesions might cause much discomfort to the patient and perturbation to the surgeon.

In the February, 1913, number of *Annals of Surgery*, Stetten reports such a case with angulation at the junction of the hepatic and common ducts after cholecystostomy which simulated common duct obstruction, and necessitated a second operation. The author mentions the fact that Kehr attributes this complication to faulty technic in the operation, but I agree with the author that it is possible to get this result without fault in the technic from the standpoint of drainage, and it may be due, as he says, to the operation *per se*. Kehr believes this sequel to follow too great tension on the gall-bladder in attaching it to the abdominal wall; but if the method which we have been using for the past ten or twelve years be employed, viz., of fixing a tube in the duct and inverting the gall-bladder around the tube by what might be termed a Lembert purse-string suture, traction on the gall-bladder cannot possibly ensue, and in the cases mentioned in which this method was utilized there was obstruction notwithstanding.

In discussing cholecystostomy, even the simplest and most uncomplicated cases, I would again call attention to the fact that the incision should be amply large to permit the introduction of the entire hand within the abdomen, and the complete palpation not only of the gall-bladder but of the cystic and common ducts. No operation

upon the gall-bladder is complete until this is done. Even with manual palpation through a sufficiently large incision, enlarged glands may sometimes be mistaken for calculi resident in the ducts, and *vice versa*. In one of our last cases, a patient of Doctor Buckner, of Shelbyville, from whom 66 calculi were removed, it was still believed at the conclusion of the operation that there was a stone, possibly in the cystic duct. Not finding the calculus with a scoop after careful sounding of the dilated duct, and being unable by manipulation to return it to the gall-bladder, the area was more completely exposed, when, on inspection, it was found that the supposed stone was an enlarged lymphatic gland! The operation had been prolonged (not unnecessarily, we think) some twenty minutes in the effort to demonstrate that there were no other calculi present before closing the incision. It should be insisted upon that, not only in cholecystostomy for stones but in operations for calculi in any portion of the bile tract, unless it be in the hepatic ducts, the operation is not complete until every stone has been removed. It is the failure to do this which has led to the supposition of the re-formation of calculi, *i.e.*, to the belief that they form subsequent to operation. In the rather large number of cases that have come under my observation recurrent stone in the gall-bladder has never been known. Secondary formation of stone is due either to imperfect and improper suturing about the choledochus tract, in that the suture is passed into the lumen of the duct or the gall-bladder, or to incomplete removal of the calculi. For the satisfaction of the patient and for one's own peace of mind it is, therefore, better in doubtful cases somewhat to prolong the operation and make assurance doubly sure,—in fact, a certainty,—rather than to take the patient off the table sooner and have subsequent trouble from this source. Granting proper introduction of the suture, all recurrent stones are overlooked ones remaining from a previous operation.

Third.—Cystic duct obstruction from calculi, with or without stones in the gall-bladder, is quite a different proposition from that of the cases in group two. Some of the cases of cystic duct obstruction might fall into group one, but we now have in mind cases of cystic duct obstruction without suppurative cholecystitis, and in this class we believe cholecystectomy is most frequently demanded. The reason for this belief is the fact that stones long existent in the cystic duct not infrequently produce such changes by erosion and chronic infection of

the walls of the cystic duct that subsequent to removal of the calculi contracture ensues, and that permanent cicatricial obstruction is the result. In such instances the fistula does not close, the usual history being that, notwithstanding the cessation of the discharge of bile, the fistula continues to pour out more or less mucus, to the great annoyance of the individual. I do not say that no other cases of cystic duct obstruction demand cholecystectomy, but in my experience it has been in this class that the gall-bladder has usually been removed. If the obstruction is recent and the calculus large, cholecystectomy has not been demanded, as a rule.

As to the technic of the operation little need be said. Absorbable material should be employed for ligating the duct, and a cigarette drain adjoin the stump, which, if possible, should always be inverted. In several cases in which it was thought cholecystectomy would not be necessary, a mucous fistula persisted for some months, but our judgment in these cases was finally vindicated by closure of the fistulæ, without subsequent trouble.

One such case was that of Mr. S. (No. 1083), who was referred to me by Doctors Weidner and South on account of constant pain in the umbilical region. He presented some symptoms referable to the gall-bladder, and during an operation for the cure of an umbilical hernia, which was the chief cause of his discomfort, several calculi were found in the gall-bladder, and were removed. The fistula persisted for six or seven months after the operation; but, notwithstanding the fact that the discharge was most of the time entirely of mucus, that bile had drained freely, and that occasionally there was staining of the discharge with bile, it was believed that the constriction would finally open, as it did, after which the fistula rapidly healed. Since then the patient has continued in good health.

The discussion of cystic duct calculi would be incomplete without reference to one other feature, which applies not only to the cystic duct but also to the common duct, *i.e.*, the crushing of the stone before removal. It is believed that, even if a calculus has been crushed, it is impossible to remove all the particles; and if the crushing has been unintentional, it is best to remove both the gall-bladder and the duct. That the calculus should ever be crushed intentionally and deliberately we do not believe,—in fact, to crush a stone in either of the ducts does not conduce to the best results, since there will almost certainly be

re-formation of the calculi, necessitating another operation. In my cases of cholecystectomy not a single death has occurred.

One result of cystic duct obstruction may be rupture of the gall-bladder. I have observed two such cases, in both of which complete recovery took place following prolonged drainage after removing all calculi, including the obstructing stone. One was referred to me by Doctor Weidner (No. 1431), the other (No. 1216) had been seen by a practitioner and also by a surgeon, both of whom diagnosed hepatic cirrhosis. The patient not only had calculi in the cystic duct, but common duct obstruction due to a tremendous inflammatory exudate about the gastrohepatic omentum. In both cases operation was undertaken as a *dernier ressort*.

Fourth.—To group four belong the worst class of cases, from the standpoint of prognosis, with which the surgeon has to deal. During the time that the 100 cases of simple cholecystostomy came to operation we had 28 cases of stone in the common duct, in 26 of which cholecdochotomy was performed, and of these 28 cases five died, three of them in uræmic coma. One had suffered from jaundice since April, 1909, the operation being performed in April, 1912, so that a period of three years had elapsed, during which there was obstruction of the common duct.

Another case with common duct obstruction (No. 923) came to me subsequent to two previous operations performed in New Albany, Indiana,—by whom I do not know. At the first operation the gall-bladder was merely drained after removal of the calculi. I do not know what was done at the second operation, but no benefit was derived, the jaundice continued, and the fistula did not close. After opening the abdomen much difficulty was experienced in freeing the gall-bladder and ducts, a calculus being finally located in the common duct near the duodenum. In manipulating this stone, or, at least, while holding it between the thumb and finger preparatory to incising the duct, it slipped into the duodenum. Closure of the incision was followed by rapid recovery and complete healing of the fistula, since which time the patient has passed bile in the stools, has had no jaundice, and is again able to earn her living as a seamstress.

Another case of common duct obstruction (No. 1411) was operated upon about the same time as No. 1431. The woman had been jaundiced for six months prior to the operation, and had attacks

of biliary colic for eighteen months. She was referred to me by Doctor H. F. Taylor, of Mangum, Kentucky. Operation revealed but one calculus, not faceted, and dark green in color. Following drainage with the tube, suture of the duct, and cigarette drainage outside, she made a rapid recovery, leaving the hospital within three weeks.

The next case (No. 1551), also one of common duct obstruction, is interesting for the reason that 15 years previous to coming under my observation the patient had passed twelve faceted calculi from the bowel. She had, however, never been perfectly well during this period, but had suffered with indigestion and "stomach trouble," for which she had been under the treatment of a gastro-enteric specialist. During a visit to French Lick Springs, Indiana, where she had been advised to go on account of her gastric disturbance, she developed jaundice, chills, and fever. Returning to Louisville, she came under my observation, having been referred to me by Doctor Weidner, who saw her at that time. She was kept in the hospital for ten days or two weeks until all fever had disappeared, and was then operated upon, a stone being found in the common duct. I have in my collection the calculus which was removed from the common duct, also a faceted stone presented to me by the patient as one of the twelve passed 15 years ago. This case is reported as illustrating the fact that, although a number of stones may have been passed *via* the bowel, this is no assurance that calculi may not persist in the bile passages, nor is it an argument against operative procedure, provided the patient presents symptoms referable to this region, be they digestive or otherwise.

Among the common duct cases I wish also to cite one (No. 1556), a patient 36 years of age, referred to me by Doctor Demaree, of Frankfort, Kentucky, as illustrating what should and can be done in a certain type of cases by proper treatment. This woman when brought to the hospital was delirious, with high fever, repeated chills, and marked jaundice. After a number of days her temperature declined to normal, the chills disappeared, and the jaundice subsided somewhat. There were marked renal changes, with albumin and casts in the urine. Under flushing of the kidneys and purgation the condition improved sufficiently to permit operation, which was performed under gas anæsthesia by the anæsthesia-association method of Crile. Ninety-one calculi were removed from the gall-bladder and one from the common

duct, after which she made a rapid recovery, returning home relieved two weeks after the operation.

In summarizing, as has been previously indicated, it is not difficult to understand that trouble may be encountered in handling some cases of gall-stones. It is also evident, from the standpoint of mortality, that the unfavorable cases are among those of common duct obstruction. This is due to several reasons: Soon after the obstruction forms the majority of these patients have an irritative nephritis, or an exacerbation of a preexisting nephritis, and in my experience the larger percentage of common duct cases occur in persons over 40 years of age. In addition there may be a cholangitis, manifested by chills and high temperature accompanying the jaundice.

Patients with common duct obstruction from calculi, who present rigors and high temperature in addition to jaundice, are not good surgical risks, and during this stage of the disease operation should never be performed. It is in this type of cases that Kehr, as mentioned in his work and as stated by Murphy, had a mortality of 90 per cent. From correspondence with numerous surgeons I have found that they do not operate during this stage, and the opinion prevails among them that surgical intervention at this period would be followed by an exceedingly high mortality,—as expressed by my various correspondents, varying from 30 to 60 per cent. It is obvious that in these individuals operation should be postponed, and practically all of them can be safely tided over, under suitable treatment, to a non-septic interval. By this interval I mean a period when, as the result of the damming of bile behind the stone, the over-distention gradually loosens it in the duct and it floats upward, permitting the escape of the infected septic biliary secretion, after which there is not only subsidence of the jaundice but disappearance of the rigors and fever. At this time when the cholangitis is quiescent, so to speak, and the jaundice has partially subsided, operation can be performed with the least danger to the patient. But even under these circumstances the mortality is always decidedly higher than that following operations performed for stone elsewhere in the choledochus tract; it may vary from 5 to 20 per cent., depending upon the operator and the condition of the patient. In a study of the mortality following surgical operations for common duct obstruction it is impossible to take all the cases as they come *seriatim*, and draw any deductions which might

be considered final, since those with kidney disease, vascular changes, and who are advanced in years, will always show a higher mortality than younger individuals; similarly, cholangitis is not favorable to the lower mortality.

I have mentioned previously the reasons for not crushing a calculus in the cystic or common duct. Even though the common duct be opened for removal of the stone which has been crushed, it is almost impossible to remove all the fragments, and calculi will re-form either here or in the hepatic duct. It is preposterous to talk of removal *via* the gall-bladder of common duct stones which have been crushed. One has only to bear in mind the anatomy of the cystic duct to appreciate the utter futility of attempting the removal with a scoop of a calculus *in toto*, crushed or otherwise, by this route. Notwithstanding this self-evident fact, we read in the literature of the day that stones are removed by a scoop, with or without previous crushing, from the common duct through an incision into the gall-bladder!

Fifth.—During that period of time in which the 100 cases of cholecystitis came under my observation I saw five cases of acute hemorrhagic pancreatitis in which the presence of biliary calculi was demonstrated at the operation. These are here mentioned because the operation for relief of the pathology consisted in part of gall-bladder drainage. In three of the cases the diagnosis of the dominant disease was made before operation. These cases are also interesting from an etiological standpoint, and as an argument for operation in gall-bladder disease as a means of preventing pancreatitis of the acute and hemorrhagic type, the outcome of which is so generally fatal. This is a large percentage of cases of acute hemorrhagic pancreatitis to have been observed in a series of 142 consecutive operations on the biliary tract, and this group is doubly interesting because it does not nearly represent the usual infrequency of this disease. Moreover, it is a very strong argument against a statistical study of the cases of one man, as he may, and perchance does, see an extraordinarily large number of one type of cases in his practice, while another with equal or larger experience may not encounter any (or few) of this particular class.

Chronic pancreatitis has not infrequently been noted in our operations for chronic biliary disease, but this observation has become so common since Robson called attention thereto, and since our per-

ception of the relationship of the bile-duct to the pancreas and the pancreatic ducts, that discussion will not be extended along these lines at this time. In this connection, however, it must be reiterated that the possibility of acute pancreatic disturbances, often with fatal termination, should be borne in mind whenever, a diagnosis of gall-stones having been made, delay in their operative removal is advised, consented to, or at the patient's solicitation concurred in. Furthermore, it should be remembered that chronic disturbances of the pancreatic function resulting from prolonged choledochus disease are not always immediately nor completely relieved by biliary drainage. As already stated, however, this phase of the subject cannot be pursued further.

It would not be fair to conclude this paper without mention of the deaths in the series of 100 cholecystostomies, and I therefore cite the two following cases,—the only ones in this series,—as showing that even cholecystostomy is not without danger, and that we (as others) have had our fatalities.

Case No. 491 was one of chronic cholecystitis with multiple calculi, operated upon under ether anaesthesia, notwithstanding the presence of albumin and casts in the urine. It was believed that the kidney function would continue, as preliminary tests revealed no marked impairment of excretory function nor marked diminution of the urea output. On the fourth day after operation the patient began to hiccup, the urine to decrease in quantity, and, in spite of energetic efforts to reestablish normal function and to lighten the labor of the kidneys, we were unable to tide him over, and a lethal termination ensued.

Case No. 1363 (Mrs. S.) illustrates an important feature of surgical treatment, which I think should be applied to all cases of gall-bladder infection, acute or chronic. The question is that of drainage, and how long it should be continued. It has been my belief for some time, and was when this patient came under observation, that so long as the bile showed bacteria, so long should drainage be maintained. It has been my custom to make a bacteriological examination of the bile at intervals, and to keep the tube *in situ* until the drainage was free of bacteria. In suppurating cases, either with or without calculi, this is very essential, as well as in cystic duct obstruction with partially purulent contents of the gall-bladder. Failure to observe this precaution, I am sure, led to the death of this patient six or eight weeks

after the operation, and four to six weeks after her dismissal from the hospital as cured. She was perfectly well, the drainage tube having been removed at the end of ten days, and the sinus permitted to close. Acute, excruciating pain in the upper right quadrant, followed by a chill and high temperature, precisely similar to the symptoms which led to operation, caused her to again consult me, although too late to reestablish drainage. Jaundice soon appeared, and as a result of diffuse general peritonitis her demise occurred within a very short time. Here, clearly, the gall-bladder infection had not wholly subsided; there was a recrudescence of bacterial activity, rapid pus formation with over-distention, and perforation or rupture, not through the temporary fistula but into the peritoneal cavity. This was a case of acute empyema; there was no stone present, the ducts were free except for inflammatory swelling, and bile in normal amount had, for ten days, beginning twenty-four hours after operation, been discharged into the drainage receptacle.

In conclusion I would call attention to several other factors which have impressed me as making for safety in operating upon these cases. With reference to stone in the common duct, besides sepsis the danger of hemorrhage should be emphasized. This may be not only postoperative hemorrhage, but a general primary oozing, beginning with the incision and at times impossible to control, which is seen in cases where there has been prolonged cholæmia. It has been customary, and is our rule, to fortify these patients against lessened coagulation of the blood by the administration of calcium lactate for several days preceding the operation. Whether this possesses any merit it is impossible to say from my personal observation,—in fact, its efficiency seems doubtful; but because of my belief that the remedy does have some potency it has been my rule to administer it as stated. In this particular type of cases horse serum has also been injected,—but whether it was of any value I have not sufficient data to form a positive opinion. There is always danger of hemorrhage, and, if not anticipated, this may be the source of sore disappointment, much chagrin, and mortification.

In all operations upon the gall-bladder its contents should be aspirated before the viscus is opened. Adequate precautions must always be taken to prevent escape of gall-bladder contents into the peritoneal cavity, preferably by proper emplacement of sponges so as

completely to isolate the operative field. After opening the gall-bladder it is my custom to mop it perfectly dry with gauze strips before attempting the removal of calculi or proceeding with the operation.

Another feature to which I wish to direct attention is the anæsthetic. The selection of the proper anæsthetic, more notably in common duct obstruction, is of the very greatest importance, and the one of choice should always be nitrous oxide gas and oxygen. During the past eight months practically all of our work has been done under gas-oxygen anæsthesia by the anoci-association method of Crile. This consists in the use of nitrous oxide gas and oxygen to induce unconsciousness or insensibility, and the local injection of novocaine to produce anæsthesia in the field of operation. After the operation is completed the field is further blocked off by urea-quinine-hydrochloride. I am satisfied that this mode of procedure possesses tremendous superiority over older methods in the class of cases under discussion. The condition of the patient at the close of the operation will be found just as good as when placed upon the table. The method has been a valuable addition to our surgical technic, and has proved satisfactory and desirable in every respect.

In many cases of biliary disease ether is positively contra-indicated. As for chloroform, it need only be mentioned to be utterly condemned; its action upon the liver is so well known that in the treatment of cholangitis, with its probable tendency to degenerative changes in the liver-cells, of all our anæsthetics it should be least often utilized.

Each case must be thoroughly studied, accurate diagnosis should at least be attempted, and then the operation should be planned, always bearing in mind the condition of the patient with reference not alone to his local disease but to his kidneys, to vascular changes, and to changes which may have ensued in the heart muscle as a result of cholæmic poisoning, or which may have taken place in the central nervous system from the same cause. To one who understands these changes and the local pathology, its insidiousness and possible extent, not only will a careful technic, surgical skill, and judgment appeal, but to him also must the anoci-association method of anæsthesia be clearly and absolutely indicated, if he wishes to save the greatest percentage of his patients.

THE INADVISABILITY OF UNDERTAKING SURGICAL OPERATIONS WITHOUT THE CONSENT OF THE PATIENT

M. A., female, aged 22 years, was admitted to the Louisville City Hospital, October 15, 1913. Family history: Father died from carcinoma of the liver; mother died from pneumonia. Personal history: Usual diseases of childhood; appendicitis three years ago, operated upon in a Cincinnati (Ohio) hospital, and appendix removed. Menstruation established at the age of 15, and has been regular since, lasting three or four days. Present status: About a week before admission severe pain developed in lower abdomen, followed by vomiting, rigors, elevation of temperature, and quickening of the pulse-rate. A mucopurulent vaginal discharge noted at various times. Physical examination: Inspection negative except appendectomy scar. Palpation reveals tender pelvic mass upon either side, corresponding in location to the Fallopian tubes. Vaginal examination: Slight mucopurulent discharge; no evidence of childbirth or previous pregnancy. Diagnosis: Bilateral pyosalpinx; cæliotomy advised.

Since this patient entered the hospital she has been carefully prepared in the customary manner for operation, and we are ready to administer the anaesthetic therefor; but, at the last moment, she decides that she will not consent to the operation, therefore we are unable to proceed.

In this connection it occurs to me that we might profitably discuss some of the valid reasons why the surgeon should not insist upon any proposed operation without the full consent of the patient that it be undertaken. It must be remembered, as one of the most important rules of surgical practice, that the surgeon should not undertake the most trivial operation unless it be with the consent of the patient. This woman has already undergone an operation for appendicitis, and she now has disease of the tubes, and probably also of the ovaries, which should be surgically removed; but, being the mistress of her own destiny, she decides that she does not want the operation performed, and we have no right to insist.

The conditions are practically identical in private practice; the surgeon should never insist upon an operation being undertaken if the patient does not consent. All he can legitimately do is to make a careful examination, and advise the patient as to what he thinks

had best be done, then leave it to the individual to decide. It would be a great mistake for the surgeon to insist, and to try to persuade the patient to consent to an operation, no matter how trivial the procedure might appear. It is his duty, of course, after making the diagnosis to explain to the patient in such a way as to be perfectly understood the nature of the pathology present, and what the probable outcome will be either with or without the operation. If there exist a lesion which is imminently dangerous, the individual should be informed that life in all probability can not long continue without the removal of the pathology; if the lesion is merely a menace to the future health and well-being of the individual, this fact should be explained, leaving the patient to decide what shall be done; but under no circumstances has the surgeon the right to insist upon an operation, nor unduly to influence the patient in arriving at a decision.

The foregoing statement is made because in performing any operation, especially where a general anaesthetic is required, the surgeon is virtually taking a human life into his hands, and he has neither moral nor legal right, by persuasion or otherwise, forcibly to subject the patient to any procedure or to place him in any surroundings or circumstances which may be a menace to life, or wherein life may be lost. It must be remembered that the art or science of surgery is not exact; but, even if it were, the element of human error must always be considered. While the surgeon may exercise extreme caution in making his physical examination and diagnosis, resorting to all the known confirmatory laboratory tests, and may be morally certain that the patient has a given pathological lesion,—be it carcinoma or other intra-abdominal disease, even diffuse peritonitis the cause of which may be unknown,—still is he liable to err in the execution of his operation. Neither our methods of diagnosis nor our diagnostic ability have as yet reached the stage of exactitude where one can figure precisely, as in a mathematical proposition, and there is always the possibility of a mistake being made.

Therefore, because of the possibility of error on the part of the surgeon, it becomes a serious matter to attempt to force an operation upon an unwilling patient, or even to overpower him mentally, or by mental insistence to induce him to undergo an operation which, at the time, he may have been reluctant to have performed.

As an illustration permit the brief citation of a case which occurred

in my own practice, where the patient and her family desired that an operation be performed, but which, fortunately, was not undertaken. A woman of 45 years, from Central Kentucky, came to Louisville to consult me in regard to the removal of an abdominal tumor. Even after careful anamnesis and painstaking physical examination nothing positively indicated a particular intra-abdominal lesion, and it became a difficult matter to decide whether the enlargement present was an ovarian cystoma, a uterine fibroid, an encysted tubercular peritonitis, or a malignant neoplasm involving the intra-abdominal viscera. There was abdominal tenderness with a pelvic mass which appeared to be slightly fluctuating, the woman had menstruated regularly, the last period being six weeks before she entered the hospital, and it was difficult to decide what the pathology might be.

Investigation of the blood of the patient shed no light upon the perplexing situation. Physical examination of her thorax revealed a fairly active tuberculosis. Pregnancy was considered, but radiography revealed no outlines within the pelvis which might be presumed to be a *fœtus*. There were no symptoms of pregnancy except enlargement of the abdomen, not the slightest discoloration of the vaginal mucosa,—and we were in a quandary.

What action should the surgeon take under such circumstances? The patient and her family desired an operation performed, and her medical attendant,—a capable man, for whom I have the highest respect,—had urgently recommended it, the patient having come to Louisville for the purpose. In the absence of any definitely indicative symptoms, and considering the apparent obscurity of the pathology, the inability to arrive at an accurate diagnosis, and the possibility of pregnancy, my advice was not to undertake even an exploration at that time. When it was suggested that she might be pregnant, the patient quite insisted that this could not be true; that her youngest child was nearly twenty years old. However, I advised her to return home and await further developments. A letter received a few days ago from the family physician conveyed the interesting information that the woman had just given birth to a child!

Suppose we had been less thorough in our investigation, and, accepting the diagnosis of the family physician, had operated upon this patient, as she requested. The operation might have caused abortion with the loss of at least one life (the *fœtus*), and we would

have rendered ourselves liable to the most severe criticism for having performed it.

In addition to the reasons already mentioned why the surgeon should not undertake operation without consent of the patient, there must always be considered the danger from the administration of a general anæsthetic; no matter how infinitesimal the risk may appear, there is always the possibility of a fatality ensuing, not only from the anæsthetic but from the operation itself, regardless of how trivial it may be.

Our aseptic technic has been perfected to such a degree that from simple intra-abdominal or intraperitoneal operations the mortality should be very low; *i.e.*, our technic has reached such a stage of exactitude that an experienced surgeon should be able to open the abdomen for the purpose of exploration and effect its closure without ever losing a patient from the operation itself; but in actual practice this is not the fact. There is the possibility of fault on the part of the operator or his assistants; in other words, the human element must always be reckoned with in the possibility of error in preparation, in technic, or in some of the numerous details incident to the execution of an aseptic operation, which may introduce an element of danger. So long as surgeons remain human they are liable to err, they are prone to faults and to mistakes, and there will always be danger, even in the execution of the simplest surgical procedure, where the peritoneal cavity is invaded, and an occasional fatality will ensue. This is what Lawson Tait has called "the irreducible mortality,"—*i.e.*, a mortality which it is impossible for the surgeon to avoid. For instance, a thousand operations for appendicitis may be performed without a single death, and the next patient may die from septic peritonitis within two or three days, which simply illustrates the possibility of human error. The slightest mistake in technic, even a pin-hole in the operator's glove, may be sufficient to cause the death of the patient. While such a trifle does not ordinarily result in a fatality, the possibility remains that it may, and because it does not invariably do so is no reason why the surgeon should use imperfect gloves and trust to luck that an accident may not happen! An unclean instrument, or even the brushing of the operator's coat against a dusty surface, may determine the death of the patient. For example, if I were to rest my hand upon the railing around this arena, the dust therefrom might be deposited

upon the sheet covering the patient, a ligature might come in contact therewith, and infection thus find its way into the patient's abdomen; or an instrument might come in contact with the infectious material, and the death of the patient ensue. A drop or two of perspiration from the head of the operator deposited on the field of operation might be sufficient to destroy the patient's life. These are some of the little things which render it absolutely impossible for any one to say there is no danger in a surgical operation.

With especial reference to the danger from general anaesthetics: While it is true that the danger from ether is slight, there being only one death in about 30,000 administrations, still there is certainly this minimal danger. From chloroform the death-rate is about one in 3000 administrations. This marked difference demonstrates the greater safety of ether, which should always be given preference over chloroform as a general anaesthetic. One death in 3000 from the anaesthetic may seem a small percentage, and if one could administer chloroform to 3000 persons with a single fatality this might seem satisfactory, if it constituted the only element of danger; but no one can be certain that chloroform can be given to 3000 persons with this mortality, and, as the average death-rate from ether is only one in 30,000, the latter should be accorded preference as a general anaesthetic. With gas-oxygen anaesthesia in the hands of experts, there is a mortality of only one in about 100,000, which makes this the safest method of all.

The dangers mentioned refer to the administration of general anaesthetics by expert anaesthetists. Of course, when administered by those of less experience and ability the dangers are correspondingly increased. Any man who gives a general anaesthetic should understand all about it, he should become expert, just as every man who practises surgery should become expert. The position of the anaesthetist is just as responsible as that of the surgeon himself,—in many instances more so,—because the anaesthetist has absolute control of the entire situation; he may demand that the surgeon suspend the operation, may declare that the patient shows symptoms indicating it to be unsafe to carry anaesthesia further, that death will almost certainly ensue, and that the surgeon shall, therefore, close his operation, even though his work be incomplete.

In the hands of those who are ordinarily permitted to administer

anæsthetics in general and municipal hospitals, there is an average of one fatality from chloroform in every 500 cases in which it is given; in the administration of ether by the inexpert there will probably be one death in every 1000 cases; in the administration of gas-oxygen by inexpert hands one death will perhaps occur in every 1000 cases. Therefore, none but experts should be permitted to administer general anæsthetics, of any kind whatsoever. Of all anæsthetics, ether is the safest in inexperienced hands.

Unfortunately, in the majority of municipal hospitals the methods and facilities for training anæsthetists are either inadequate or greatly neglected, and a fatality occasionally occurs attributable to the anæsthetic. Assuming the number of major surgical operations in such hospitals to be 2000, one or two deaths per year from the anæsthetic would be about the average. This is largely assumption, but is based upon my knowledge of the training in the administration of general anæsthetics ordinarily given in municipal hospitals. Few of them have special anæsthetists, so the interne performs this duty, which is not only a just indictment against the institution, but a great injustice to the resident who, on account of the fixed rules, is compelled to subject himself to such a condition of affairs. I believe my statement is not far from correct that, in any public service institution of this character, in a series of 2000 cases there will be one or two deaths from the anæsthetic. Such a condition of affairs ought not to exist, but the fault lies with the general methods of organization of municipal hospitals, and it becomes a difficult matter to correct.

Deaths occasionally occur from the anæsthetic in the hands of the most expert, for the same reason that those handling gunpowder now and then have an explosion, for the same reason that steam boilers sometimes explode,—simply from momentary neglect of duty. A man who is familiar with the giving of general anæsthetics recognizes certain indications of danger, he follows certain rules, but the time comes when he does all these things automatically, and for the nonce, perhaps, he is not mentally alert, and an accident happens. This is, in the majority of instances, the cause of death from the anæsthetic in the hands of experts.

Rarely does gas-oxygen anæsthesia in the hands of an expert cause death, but it is extremely dangerous in the hands of those who are unfamiliar with its proper administration. An expert can prolong this

method of anaesthesia indefinitely without serious danger to the patient, as nitrous oxide gas is not poisonous, anaesthesia being produced simply by the exclusion of air; it does not poison the body-cells, but produces anaesthesia by an entirely different process. If the quantity of air permitted be insufficient the patient is quickly smothered; therefore, if improperly administered, death occurs quickly from nitrous oxide gas. However, if there be added to the gas sufficient oxygen to maintain life this form of anaesthesia may be continued indefinitely without danger. An individual cannot be starved so long as he is allowed sufficient food to maintain life, neither can he be killed with nitrous oxide gas, provided sufficient oxygen be permitted to sustain life.

In addition to the foregoing reasons why the surgeon should never urge the patient to submit to an operation, the pertinent fact must not be forgotten that it would involve an important medicolegal question: Legally the surgeon is not permitted to undertake an operation of any description without the consent of the patient if he be conscious at the time; and if unconscious, and therefore unable to give his consent, operation should not be undertaken except in an emergency as a life-saving measure without the permission of some responsible member of the family or of the patient's nearest friend.

In not a few instances the courts have awarded damages in considerable amounts to the patients when surgeons had unfortunately operated without permission, although the evidence showed that the pathological lesions present menaced the lives of the patients, and the operations were therefore demanded.

DOUBLE EQUINOVARUS; VOLKMANN'S ISCHÆMIC CONTRACTURE; INGUINAL HERNIA; EPIPHYSEAL FRACTURE OF LOWER END OF FEMUR; SPINA BIFIDA; HEMORRHOIDS

(SURGICAL CLINIC HELD AT THE COLLEGE OF MEDICINE AT THE UNIVERSITY OF ILLINOIS, NOVEMBER 12, 1913.)

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DOUBLE EQUINOVARUS

GENTLEMEN: I will show you this case of double equinovarus before the child goes to sleep. This is one of the common forms, probably comprising about six or seven per cent. of all cases of club-foot, and of this variety half are double,—that is, of both feet. This boy, past two years old, is a twin, and his twin sister is free from this condition with normal limbs. We do not know so much about the cause of these abnormalities. Intra-uterine position—pressure—is responsible for some cases. There might be more reason for that in this case—a twin. Most cases seem to result from errors of development, and they are often associated with harelip, cleft palate, spina bifida, and are not infrequently hereditary. This child has callus on the sides of his feet and on his knees. The muscles of the legs below the knees are not developed because of disuse, but you can see that he has been on his knees enough to develop the thigh muscles all right. In some of these cases there is an absence of the scaphoid bone. The scaphoid is not well developed in this case, as you will see by the picture (X-ray).

The child is now anæsthetized, and we will paint the area of operation with half strength tincture of iodine. This condition is much more frequent in boys than girls, for some reason which we do not know.

A good many of these cases can be cured by treating them soon after birth, in the first few weeks, by manipulation straightening them out. This takes persistence and a long time. You cannot get quick

results in that way, but after two years it is more difficult to do, and it is more important to get quick results; so we will just do forcible reduction here, and will perhaps have to cut the tendo achillis on one side or both.

The right foot is worse than the left. You see the tendo achillis is short. That could be brought down a little, but it would not stay. The foot can be bent so (illustrating), but it will not stay bent. A specially-constructed shoe could be worn for a couple of years and might cure this condition, but in the meantime the baby is suffering from disuse of the leg, which is not developing properly. With care we can cut this plantar fascia, loosen it up at once, and also cut the tendo achillis. The plantar fascia, and sometimes the posterior tibial, have to be cut, but not often. We will have to overcorrect this foot. We get under the skin here, and then cut inward approximately at the middle of the foot. Just at this point we have to be a little careful to avoid the internal plantar. If this were a case in adult life we might have to cut out some of the cuboid on the outer side, a wedge-shaped piece, to get it straight. As it is, the child's foot will develop into a normal shape by wearing a proper shoe. We will put it up in plaster, and the wearing of a shoe will correct it further. We will overcorrect it when we put the plaster on.

There is not quite so much of the equinus element present in the left foot, but quite as much varus. Still, I think we will get better results by doing a tenotomy. We will cut this tendon (indicating) from within outward and loosen it up, and in other details treat the same as the other foot, including plaster dressing in overcorrected position. After wearing the casts for four to six weeks, the child will have to wear shoes that will continue to hold the feet everted and at proper angle with the leg, like this (illustrating). This position gives plenty of correction in that way (illustrating), not quite enough the other way, but it will increase gradually. The tendo achillis will regenerate in a reasonable time. We also have had to overcome the contraction of the ligaments around the bones which have been displaced. The articulations are entirely changed.

If we get the child so that it can bear its weight on the soles of the feet, there will be a constant tendency to correction in the position of the foot, but in the other position there is no tendency whatever to spontaneous cure, because the malposition, throwing the weight

of the body on the side of the foot, tends to increase the deformity all the time.

VOLKMANN'S ISCHÆMIC CONTRACTURE

This case had a fracture of the ulna near the elbow three years ago. I did not see the patient for a long time after, and when I did see her she had an extreme flexion of the wrist and fingers. By exaggerating the flexion at the wrist I could straighten the fingers a little, and that was all. The condition was so bad that I concluded to first elongate the tendons, which I did, so as to allow extension, which she is now increasing by manipulation. This case progressed nicely without infection. The scar is on the palmar side, but you see how the belly of the muscles of the forearm is atrophied. The etiology is pressure, which produces myositis—the pressure of bandages too tightly applied, as in this case, when she developed an œdema of the fingers, followed by pain and this severe contraction. This contraction did not take place in the tendons. It is not like Dupuytren's contraction of the fascia, where the fingers are drawn up, but the contraction took place from cicatrization of the muscles where the inflammation occurred from pressure. That is generally agreed on as the pathology. The nerves have little or nothing to do with it, excepting as they are involved in the inflammatory process in the muscles. Experiments have shown that a severe continued pressure of the muscles in the arm or leg may be followed by similar results in three or four hours, and that the damage in these cases is done in the first thirty-six hours. This patient is using forcible extension; the wrist has gained twenty-five per cent. in ability to straighten out the arm; the fingers have gained materially even since the elongation of the tendons. If this case stops improving by manipulation, it will be helped by an apparatus devised by Alexander. The plan is to have a padded palmar splint and a wrist splint, with braces on the side and a ratchet in the shaft. The ratchet can be controlled by the screw which you see in the illustration on the blackboard. Operative measures have not been very successful in these cases. Various ones have been done, including trying to isolate and loosen up the flexor muscles, mainly the sublimis, but that is not followed by very good results, as a rule, as you add traumatism to already traumatized muscles. I believe the best treatment for these cases will prove to be

manipulation and gradual extension by means of some apparatus like the Alexander. Of course, any other plan which would look toward the gradual extension by elastic bands, or what not, would answer a similar purpose. This child was operated on a year ago. She is twelve years old.

INGUINAL HERNIA

This little patient is a little over two years old. He has had a hernia all his life, as is the history in a good many hernias. He has worn a truss for a year, and it is impossible to retain the hernia with the truss. Most of these cases in children can be cured by wearing a truss, but, if they are not cured in a year or two, operation is indicated. Regarding the kind of truss used, they are much the same except in name, and their variety, of course, is numerous, but the one I prefer is a spring cross-body truss. Most of these cases can be cured by a truss, but the difficulty is that we send them to the instrument maker and then forget them. If the patient has club-feet, we have him come back every month; and if we took the same precaution with a hernia case we could often cure it. It is a matter of patience and seeing that the truss presses in the right place. The reason why trusses fail so often in children, and more often in adults, is because we don't keep them adjusted right. It takes very little pressure, if adjusted in the right place. But any case that is not cured by six or eight months' wearing a truss probably ought to be operated on, except those too young or in which for some reason operation is contraindicated; because the mortality of hernia operations at the present time is very low, and the failures to cure are very few in number.

Hernia, again, like some other deformities, is in large measure a hereditary condition, and the chapter on hernia has been rewritten of late years; because frequent operations have demonstrated that, instead of being the result of an injury or traumatism, it is nearly always the result of a defect in development. That is a very important point, in view of the workman's compensation law and the personal damage cases that so many times arise. A man claims that he was hurt and had a hernia following the injury. In nine out of ten cases, or, more probably, thirty-nine out of forty, it is not due to the accident alone, but to a maldevelopment, waiting for some exciting cause to produce a hernia. A good many cases at autopsy have

shown potential hernias, undeveloped,—unfilled sacs that were there during life and no hernias developed because the exciting cause was absent. For that reason it is a very difficult thing to prove that hernia is the result of an accident. The courts demand proof that there was no hernia before the accident; that hernia was present just after, and it is almost necessary to prove that there was pain at the time of development—sudden stretching of the peritoneum causing pain. Most hernias come with very little pain. In case one had a recent examination and had hernia immediately after injury accompanied by pain, and the accident was of such kind as to produce special strain, it would seem competent.

A DOCTOR.—What pathognomonic signs are necessary in order to satisfy the court?

DR. HARSHA.—I think the most satisfactory evidence would be that the man would prove that he had no hernia before, but immediately after the injury had a hernia and had pain with the hernia. Of course, that would go far in court.

I do a modified Bassini operation, because in children it is not so necessary to transplant the cord. I have some cuts on the wall, which you perhaps can make out, showing the different operations for hernia, but nowadays surgical operations are very much standardized. The sac of the hernia lies in the same position in the child as in the adult,—that is, anterior to the cord. Here is the sac. It is, perhaps, a little harder to dissect off in children—it is a little more delicate—but the main thing, in which all surgeons at the present time agree, is the obliteration of the sac. Ochsner's operation for femoral hernia demonstrates that point. This sac is continuous down with the testicle. We have to dissect out as much as we can of it and separate it. We cannot easily dissect all of it out, but we can put a catgut stitch in to keep it from favoring a hydrocele, which it does sometimes. Now, in adults, where the tissues are a little stronger, we peel them off with gauze a little better than we can here. We now have to avoid the vas, which is not as prominent in the child as in the adult. We will get this sac up as far as we can in the internal ring. I have split the external oblique muscle in the direction of its fibres. We hold the testicle down and it goes back into its place. I have shown that there is nothing in the sac.

The late Dr. Ferguson's operation was without cord transplant,

and he claimed just as good results. However, the latest figures do not go to prove that. Most authorities claim—at least, those who have had the largest experience—that the results are better with a transplantation of the cord in the adult.

A newer operation is where the external and internal oblique are both brought over to the shelving portion of Poupart's ligament. For stitching the internal oblique and transversalis to Poupart's ligament, No. 2 chromic interrupted catgut sutures are used. I sometimes use kangaroo tendon, which I believe is better than any other suture material, but it is a little heavier, and in children is perhaps not quite so essential.

I have brought the external oblique right over with continued suture.

The causes of hernia that are usually enumerated do not amount to much, in my opinion, except weakened abdominal walls. A long mesentery and a phimosis, for instance, and all of those minor factors have very little to do, in my estimation, in the causation. It is invited by a performed sac in most cases, and then some exciting cause. In direct inguinal there is yielding of muscle more often. Constipation will help develop a hernia. A nurse who would rather give the baby paregoric than take care of it will sometimes invite a hernia in that way.

EPiphyseal Fracture of Lower End of Femur

This patient was fourteen years old when he collided with a street car, and had an epiphyseal separation of the lower end of the femur, of the condyles, a simple fracture at the middle of the femur on the opposite side, also a Colles's fracture of the left wrist and a concussion of the skull, associated with some concussion of the brain. It was several hours before he knew anything. His condition was so bad that his doctor did not think it best to try to correct these conditions. I did not see him until nearly four weeks after the accident, and at that time the condyles of the femur stood straight out at right angles from the shaft of the femur, and the patella and tendons were stretched over that.

Epiphyseal separations of the lower end of the femur are not very common. In the Massachusetts General Hospital, where they have thousands of fractures every year, they had in fifteen years

(1898-1913) thirteen simple fractures of that kind, and most of them occurred in patients from six to eighteen years of age, and only a few of them could be thoroughly treated, even in the early stage, without operation. Some of them lost their limbs—five out of the number. There were five compound fractures.

In this case, four weeks after the injury he was in pretty good condition. I operated, making a U-shaped incision below, through the patellar tendon; then I had to chisel the condyles loose—they had united rather firmly; then I replaced the distal fragment. Then we were against the problem of making a leg of normal length, because in these four weeks these muscles had retracted, the capsules had contracted, and we had a permanent and organic shortening and retraction of the muscles. It was a question whether we should take the head of that bone out, make a new joint, and have a permanent short leg, continually getting shorter by comparison, as the other leg would keep growing, or conserve as much as we could the value of the joint and still maintain the length of the leg, and we took a chance on keeping the length of the leg. When we cut through the capsule, of course it retracted. When we got the condyles back on the femur, the bone had elongated an inch and a half, and we had not sufficient length of capsule to reach. We spliced the capsule by fascia dissected from the upper end of the tibia and elongated the tendon. I put the nails in the side of the condyle, where they do not bear any pressure. He has worn these nails for two years, and they give him no trouble. The other side, in which there was a simple fracture with shortening of approximately an inch that had not been reduced, was next treated. After refracturing we put a stretcher on, such as orthopædic men use, elongating the leg as much as we safely could. In the four weeks since the injury it had united with considerable deformity. Under ether, with the leg over the end of the table, it was easily broken down. We put it up in Buck's extension and got a very fair result. The leg has been growing some, and there is now very little difference between the two. The young man is now sixteen years of age. The legs are practically the same length, and the young fellow will not grow so much more, and his legs will be fairly mated as to length when he has completed his growth. We took every possible precaution to prevent infection and had a prompt union.

SPINA BIFIDA

This lady has been kind enough to bring this little patient in to show the result of a spina bifida operation. The child was three months old when operated, and is five years old now. It was rather favorable for operation, because low down. The tumor was about the size of a coffee cup, and more than a meningocele, involving some of the nerves. There are three grades of these tumors, due to defective closure of the canal: First, meningocele, where only the meninges are involved; then the myelomeningocele, where the elements of the cord are involved, and then where the whole cord is involved. Then there is another type where there is no tumor, but there may be a little tuft of hair and a defect in the closure of the posterior spinal canal. I should mention that there are other varieties, posterior and anterior, cases where the bodies of the vertebra are not developed and where the tumor bulges into the abdomen. Then, of course, you cannot make a diagnosis. A number have been operated on under the diagnosis of abdominal tumors, and only at operation was the true character of the tumor demonstrated. Operations for spina bifida are in most cases fatal. I have operated on thirteen, and three of these are living.

This child had secondary involvement of the nerves; he had the special nerves involved here (indicating). If the condition is located below the eleventh dorsal vertebra in the child, then there is more hope of restoring function than if above, because the cords of the cauda are more amenable to treatment. In fact, if you have to resect one of those, you can get union; but you cannot in the cord, because they have different histology.

This child got along without infection and had a better result than I expected. He had incontinence of urine and faeces until several months ago. Now he has control of the faeces and is fast gaining control of the urine. The chances are fair that he will recover that. A good many children who have not had spina bifida do not have very good control of the bladder until nine years old.

Some of these cases are better off if they do not live. Where they have the second and third degrees they are often better off if they do not recover. I had one case in this clinic that had already ruptured. I operated and, of course, it had become infected, but it lived for

three months. It had a hydrocephalus, and on tapping the ventricle abundance of pus was found.

In the etiology of this disease we see again the same sort of thing that I spoke of before. There are other evidences also of malformation, such as club-feet, an undeveloped penis, etc. Hydrocephalus is a very common sequel to operations of this kind, and it suggests that there is more than an element of defect of the spinal canal involved in the etiology. It suggests a pressure, and that suggests a low-grade inflammation of some kind in the cord or ventricles of the brain. In four or five of my thirteen cases we had some degree of hydrocephalus following the operation.

Of these malformations we often see cleft palate. Some years ago there was a fad started of starving pregnant women so that they would have easy labors. Professor Mears, of Philadelphia, several years ago, in *Annals of Surgery*, reported on some observations that he had made with reference to cleft palate. He noticed in the Zoological Gardens in Dublin that when the female lions were deprived of the ordinary elements of their food their young were born almost uniformly with harelip and cleft palate, so they could not suck. So they started in feeding them crushed bone, cartilage, and muscle, and corrected all that. So, in the human, it may be that many cases where that deformity is present the mother has been undernourished; at any rate, it points the moral: The prospective mother should not be starved.

HEMORRHOIDS

There are several penalties we pay for standing upright—hernia, hemorrhoids, and appendicitis among them.

This woman has been a private patient of mine, and came to me some years ago with an enlargement and induration of the breast. Careful inquiry elicited the history of lues. Whenever a rectal or anal trouble occurs in a luetic patient, we have to look out for tertiary signs. Some months ago she applied to me for treatment, and I put her on iodides. She now comes to me with protruding hemorrhoids, which she wants removed.

These are very common and easy cases, but they are "fundamental." If we do not have a Paquelin or hot iron, then we clamp

and ligate them and cut them off. In this case also we ought to use as much care as we can, although we know that we are in an infected field.

The first lecture I ever heard on diseases of the anus and rectum was by the late Edmund Andrews, one of the best men Chicago ever had, and I remember perfectly well how he used to say to look around first and see whether there was any little sentinel pile which would indicate a fistula, and then feel around to see if there was an induration, and so determine an abscess or blind internal fistula, and then, failing to find either of those, look inside. (They say that the lawyer sees the worst side of people, the preacher the best side, and the doctor the inside.)

When you dilate, the anaesthetic should be withheld a little, and so that is what we are doing now. The stretching has a good deal to do with curing hemorrhoids. There is a slight fissure here, in the place where they most often occur, namely, in the posterior commissure, and I dare say her pain and symptoms were as much due to that as to the hemorrhoids. The stretching is, of course, an absolute necessity in curing that part of it. It takes a little more dilatation and stretching to get a sufficient paralysis than one would think, because of the resiliency, and in this case there has been a spasmodic sphincter present.

In ordinary work, in abdominal and superficial work, and especially in adults, I like to use the nerve-blocking method, and have been using it a great deal in my work at St. Luke's Hospital for several months in cases of hernia, appendicitis, breast tumor, and that sort of operation where it is applicable. I believe it is a great help. Crile has popularized it under the name of anocci-association. This is the method, I believe, of the future, of causing anaesthesia with novocaine, 1:400, infiltrated in the tissues, and then quinine urea, one-half of one per cent., used during the operation to anaesthetize longer. I have used that in hemorrhoids, just the novocaine—not the quinine—because the quinine, used in sufficient quantity in this area, is liable to produce oedema. In order to prevent this oedema, in some clinics they make multiple punctures around the edge of the anus so that the serum from the oedema will exude. I have used the novocaine to advantage, one-quarter of one per cent., and at four points, just about like this (indicating), only one-half to

one inch away from the anus, and inject it in three directions from one point.

The hemorrhoids in this case are not large. Here is where the little ulcer was, right at the bottom. If there is a redundancy of the skin, we take that off. I usually use a Paquelin cautery, but these small soldering irons of Dr. Ochsner's do just as well if the surroundings are protected. We have to be careful not to involve the sphincters. I generally complete the operation by putting in a tube covered with gauze. The gauze soaks up the secretions perhaps better than the rubber tissue so commonly used.

A MEMBER.—Will that not cause a lot of pain on removal?

DR. HARSHA.—We usually give one-twelfth grain of heroin to control pain and quiet the intestine, repeating as necessary. The tube will come out easily after twenty-four or thirty-six hours. It prevents hemorrhage and helps protect the wound from infection during the most susceptible period. We are apt to think of this as an infective field that has developed some immunity to infection, and that, therefore, we need not exercise so much care as elsewhere. That is wrong. We are taught that it takes extra precaution to prevent infection in bone work, and we are told we should not unnecessarily traumatize the tissues in operation on diabetics. We are taught that the brain and membranes have less resistance to infection than the abdomen, and all these premises are granted. But should we not use every possible precaution in operating upon the rectum or the abdomen, and what more can we do in operations on the brain or in amputations on diabetics or in bone work?

CONSERVATIVE VERSUS RADICAL TREATMENT OF TUBERCULOUS JOINT DISEASE

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IT is reasonable to expect that surgery should precede or supplement the older and conservative methods of treatment in tuberculous bone and joint disease. In fact, surgery has not been slow in invading this particular field with the expectation of eradicating the focus of disease and shortening the long period of treatment necessitated by conservative methods.

The relative merits of conservative and operative treatment of tuberculous bone and joint disease in children are still in the controversial stage. This mooted point is undoubtedly the natural sequence of inadequate knowledge of the pathologic process. A rational basis of treatment can only be formulated when the pathology is better understood.

The orthopædic surgeon prefers to rely upon the conservative method rather than the surgical, not only because it is less destructive in its permanent results, but also because the natural tendency of tuberculosis of bone and joint disease is toward recovery. While Nature, unaided, cures tuberculous bone and joint disease, the results are usually deformity and ankylosis. In her effort to protect the sensitive joint from injury the limb assumes an abnormal posture, such as flexion and adduction in hip disease, and if allowed to persist results in deformity. Ankylosis, too, is Nature's method of repair and represents the extensive inflammatory and destructive changes in the structure of the joint. It is, however, no longer looked upon as an unnecessary evil, for it has been pointed out that when bony union of a joint occurs the tuberculous process rapidly disappears. To allow a little motion in the joint is worse than no motion at all, and is often the starting point for relapse, partly due to the friction to which the part is subjected.

With the surgeon's aid, Nature can be assisted by promoting such general conditions as will favor repair, add to the healing of the diseased bones, and also conserve functional use. It is with this aim that tuberculous bone and joint disease is treated conservatively, varying somewhat in accordance with the views of the individual surgeon. Conservatism implies carrying out the "principles of physiological rest" by some form of orthopaedic appliance, such as a cast, a brace, traction in bed, etc. Careful and efficient protective treatment, with such general conditions as will maintain the patient's resistance above normal, succeeds in curing the patient in the shortest possible time and with minimum loss of function.

Surgical procedure should be resorted to only as an adjuvant measure, and not as the primary method of treatment in children. These views are not based merely upon superficial observation, but are the product of long and varied experience.

As an adjuvant measure operative procedure is resorted to for correction of deformity; for the relief of pain in abscess formation due to distention of the capsule or tissue surrounding the joint; in extensive, progressive, multiple tuberculous affections of the joints in which conservative treatment has been tried and failed, and in cases where symptoms of septic absorption are so severe as to endanger the life of the patient. On the other hand, radical surgical measures for tuberculous arthritis have the greatest application and the greatest probability of success in adults, inasmuch as they shorten the period of disability with a presumption of a rapid cure. But such radical measures necessarily produce a permanent immobilization of the joint with shortening. In children a radical operation, such as excision, cannot attain the results that it has set out to accomplish. Not only does it involve a sacrifice of bone, which by conservative methods is spared, but it causes a crippling deformity in after-years by the disturbance of growth. Then, too, there is no assurance of a rapid cure. The reason for this is that the structure of bone in children differs materially from that in adults. The marrow tissue varies considerably in appearance and structure in the young and in the adult. It gradually disappears from the shaft of the long bones, and after the fourteenth and sixteenth years assumes the character of ordinary adipose tissue. The red marrow persists in the cancellated ends of long bones, and is especially characteristic of the

short bones, the ribs, and the cranial diploë. It is in the highly vascular and cellular spaces in the shaft of bones in infancy and childhood and in the epiphyses in adults that tuberculosis occurs.

Ely has advanced the theory that tissues containing lymphoid and epithelial cells are affected by tuberculosis; that the red marrow of bone and synovial membrane of joints are favorite sites for the tubercle bacilli, while fibrous connective tissue, ligaments, yellow marrow, muscle, etc., are not. Keene, too, attributes tuberculous bone disease to infection of bone-marrow.

According to Stiles, the location of a primary tuberculous focus is commonly in the metaphysis of bone, and the initial invasion by the tubercle bacilli is accounted for by the distribution of the three systems of intra-osseal vessels whose "ultimate branches anastomose in the region of the metaphysis, so that by whichever of the three routes the bacterial embolus finds its way into the bone, it is in this last situation that it is most likely to be arrested." He thinks slow circulation is also a circumstance which makes this a favorable site for the deposition of the tuberculous embolus. He further believes it to be a matter of chance that the disease begins primarily in the bone and not in the synovial membrane.

From the foregoing it may be inferred that the cancellous tissue of bone and the synovial membrane of joints are most susceptible to tuberculosis in the order named. In adults a primary tuberculous focus is most commonly situated in the epiphysis and less frequently in the synovial membrane, whereas in children it is situated either in the synovial membrane of joints or more frequently in the diaphyses of long and short bones, rather than the epiphyses. The latter, being largely cartilaginous tissue, are never primarily attacked by tuberculosis. Wherever cancellous tissue exists, as in the shafts of long bones of young children, tuberculosis may occur, thus indicating that, no matter how skilfully excision of a joint may be performed, some of the tuberculous tissue must remain. It is interesting to note in this connection that when we were using bismuth paste so extensively at the Home for Destitute Crippled Children, some years ago, about 40 per cent. of the cases treated were tuberculous sinuses resulting from excision of the head of the femur.

While it cannot be denied that conservative treatment of tuberculous joint and bone disease ultimately gives excellent results, yet we

cannot lightly pass by the brilliant results effected by the surgical treatment of Pott's disease. Even the most conservative orthopedic surgeons are inclined to replace conservative for surgical methods. Some go so far as to advise immediate operation for Pott's disease.

Surgery here shows to a better advantage than in tuberculous bones elsewhere in the body, for there is no sacrifice of bone to effect shortening, and it diminishes the possibility of disseminating the infection into contiguous normal bone.

The radical treatment of tuberculous spine disease consists of transplanting a bone splint from the crest of the tibia into the spinous processes of the diseased vertebrae, thereby producing ankylosis of the area and securing perfect immobilization.

In the consideration of the conservative treatment of tuberculous bone and joint disease, general hygienic methods as well as good nourishment are necessary and especially valuable. Fresh air, sunlight, forced diet, tonics, etc., are no less important in surgical tuberculosis than in tuberculosis of the lungs, improving thereby the general health and increasing the natural resisting power of the patient.

The tonic value of *sea air* and *bathing* is now generally recognized: it shortens the course and produces a better functional result. In the ambulatory cases plaster casts, braces, etc., are removed previous to bathing and reapplied afterward. The acute cases are carried into the water on frames.

The *sun-cure*, or heliotherapy, as it is called in Europe, is being advocated. The exponent of this treatment is Rollier, of Leysin, Switzerland, who cures surgical tuberculosis by solar radiation, effective upon the high mountain slopes. He believes that solar radiation has not only an extraordinary invigorating action, but is a most powerful bactericidal agent.

Rollier, though an able surgeon and former assistant of Kocher, restricts surgical measures to opening abscesses. He does not neglect, however, the usual means of treatment. His method of treatment by solar radiation consists in exposing the affected part to the sun two or three times daily for a short period in order to avoid sun burning, then gradually increasing until the children, absolutely naked, spend over six or eight hours in the sunlight, where they become almost walnut brown in color. Even in winter they lie on a

balcony almost naked. The tolerance is explained by the circumambient air being very hot, even reaching 113° to 120° F. in December.

Local treatment, though varying according to the patient's condition, should be, whenever possible, ambulatory, for confinement to bed does not produce results as good as those obtained from outdoor life.

The first care must be to protect the joint from irritation due to friction resulting from functional use. In hip disease, for instance, the joint is only slightly susceptible to pressure while highly sensitive to movement, hence the immobilization of the affected part is essential for a cure.

In early cases, before the appearance of deformity, protection is obtained with the greatest degree of efficiency by means of braces or plaster-of-Paris casts. The latter, in my experience, have given the best results. One of the objectionable features of braces is the ease with which they can be removed, thus tempting an uncontrollable child or a too sympathetic parent to remove the brace during certain periods of the day. Immobilization is then ineffective and cure retarded.

Protection should be given with the joint in the most favorable position. For elbow disease the forearm should be at right angles to the arm and a plaster cast applied from the wrist to the armpit; for knee-joint disease the leg should be fully extended and the cast put on from the ankle to the groin; for hip-joint disease the limb should be in a position of 20° abduction, 10° flexion and outward rotation, and the plaster cast should extend from the ankle to the middle of the thorax; for Pott's disease the spine should be hyperextended and a cast applied from the upper end of the sternum to a little above the greater trochanters. If the disease is above the eighth dorsal vertebra, the chin, too, should be included. At times it may be necessary to include the foot in the plaster cast for knee- or hip-joint disease, or the hand for elbow disease, to more fully relieve the muscular spasm and pain. Every six or eight weeks the cast is removed, the skin is cleansed, rubbed with alcohol, powdered, the diseased joint examined, and new casts continually applied until all the pain and muscular spasm have disappeared, or until such time when braces can be applied.

If the disease is particularly active, as shown by severe pain and

marked muscular spasm with flexion deformity, recumbency on a Bradford frame with traction in the line of deformity by weight and pulley is advisable for hip and knee disease, while for ankle and elbow disease traction is not practicable. For Pott's disease the Bradford frame is slightly arched, which hyperextends the spine, but traction with weight and pulley is unnecessary unless the cervical or upper dorsal regions are affected.

In the less active stage of the disease with existing deformity it is of primary importance that correction be made before ambulatory treatment is permissible. The more resistant deformities can be reduced under anaesthesia by manual traction and by leverage, and the less resistant ones without anaesthesia. When the desired position of the limb is attained, fixation of the joint is best secured by a plaster cast.

There is an increasing tendency toward avoiding weight extension in bed as a routine procedure because it confines the patient, and fixation is imperfect. However, recumbency with traction should be maintained in the active stage of the disease to relieve pain and to overcome the distortion due to muscular spasm. Recumbency, with or without traction, should be also encouraged in patients who have become emaciated in the course of the disease, due either to lack of treatment or to being improperly treated. Then, too, recumbency is advisable in abscess formation and also when the temperature of the patient is over 100° F. during any part of the day. Such procedure results in a most gratifying improvement, as shown by increase in weight, lower temperature, and, in a vast number of cases, by the disappearance of the abscesses.

Many orthopædists of experience consider the weight-bearing method of Lorenz valuable in hip disease. This permits the weight of the body to be borne by the affected limb, but with fixation of the diseased joint. Following out Lorenz's theory, Wilson, after an extensive clinical experience, believes that weight-bearing is not only harmless if the joint be free from friction, but is beneficial, inasmuch as it stimulates circulation in the affected limb and also allows the freedom of outdoor life.

After a time, when the disease has ceased to be active and the patient is on the road to recovery, braces may be substituted for plaster casts. They offer protection to the joints and allow inspec-

tion and cleansing of the parts. When the patient is apparently cured, the brace may be allowed off at night and then for certain periods of the day only. If there is no return of symptoms, the brace is gradually discontinued. I say advisedly "apparently cured," for it is almost impossible to say when the joint has ceased to be diseased. A tuberculous focus may be but partially encapsulated and lying dormant, yet give no clinical symptoms, needing only some irritating circumstance to light up the disease.

Abscess formation complicating joint tuberculosis is best treated expectantly. We know that if abscesses are left alone they disappear without any treatment in at least 20 per cent. of the cases, and that this percentage can be largely increased under the treatment of recumbency. Then, too, the risk of a secondary pyogenic infection is less if abscesses are allowed to open spontaneously.

With the advent of the bismuth paste, abscesses are indiscriminately opened, evacuated, and filled with the paste. Sinuses of tuberculous joint disease are also injected with the bismuth paste, which is a more rational procedure.

It is doubtful if bismuth exerts any therapeutic action in tuberculous sinuses, though Beck believes it creates a leucocytosis. It is more reasonable, however, to consider the action of the paste as being chiefly mechanical, for by plugging up the sinus it dams back the pus, excludes the air, and prevents entrance of pyogenic bacteria, all of which are favorable factors for the filling in of the sinuses with granulations. Clear vaseline injected into a sinus exerts the same influence as when containing bismuth.

Experience with bismuth paste at the Home for Destitute Crippled Children has shown that the greatest success has been attained in old sinuses of tuberculous joint disease which have been discharging for one or more years, and that they could be cured in seven days to two months, but that new channels would form as an outlet for the tuberculous *débris* coming from the seat of disease; that abscesses would heal up in thirteen to twenty-one days, but later would refill with pus and then open spontaneously. This led us to abandon the use of paste in sinuses or abscesses in joint tuberculosis where the disease was still active, as it did not favor cicatrization of the new tissue nor destroy or encapsulate the tuberculous focus.

The exact value and place of tuberculin in orthopædic practice is still unsettled. However, I believe it is current among orthopædic surgeons that its use is not so promising in this particular field as it is elsewhere. In my own practice it is no longer administered. Some years ago, at the Home for Destitute Crippled Children, we selected a certain number of cases of tuberculous joint disease as near alike as possible: one-half of these cases were given tuberculin for nine months according to the method of Wright. At the end of this period the patients who had been given tuberculin did not show any greater improvement than those treated without it. Then, too, from a careful study of reported cases treated with tuberculin, the conviction has grown upon me that tuberculin, in ordinary doses, has no curative value in bone and joint tuberculosis. One of my colleagues, whose opinion I greatly respect, states that "tuberculin administered by the clinical method in harmless doses is useless; administered in larger doses it is both dangerous and harmful."

In conclusion I wish to emphasize the fact that conservative treatment assists Nature in her reparative methods, and that until such time when the pathology of bone and joint tuberculosis will be more clearly understood and defined it is best to adhere to the methods that have given us the most successful results, which is by the slower but surer method of conservative treatment.

SOME UNUSUAL SURGICAL CASES, WITH REMARKS

BY CHARLES GREENE CUMSTON, M.D.

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Primary Carcinoma of the Fallopian Tube.—Mrs. J. H., aged 52 years, two pregnancies with living children. Menopause two years ago. For the past four months, without any known cause, the patient has been tormented by rather acute paroxysmal abdominal pain, particularly in the left iliac fossa. During the same time she has had a watery, rose-colored vaginal discharge which has increased very decidedly during the past six weeks. Since the menopause no blood or clots have been passed.

Physical condition generally good. Urine normal; heart and lungs negative; bowels regular.

Pelvic examination showed an atrophic uterus pushed slightly to the right by an oval tumor on the left about the size of a small orange, apparently arising in either the tube or ovary. On account of the watery discharge a malignant growth was suspected, although careful palpation of the pelvic cavity and inguinal region did not reveal any enlarged lymph-nodes. Operation, being advised and accepted, was done on October 16, 1912.

Upon opening the abdomen a tumor was found in the left Fallopian tube which was very dark red in color. There were a few thin, recent adhesions of inflammatory type which were easily broken down and the tumor freed. The left ovary was in a marked state of senile atrophy, while the right tube was normal and its ovary atrophic. The parametrium was not thickened, and no enlarged lymph-nodes could be discovered in the pelvis. After freeing the tube, which was an easy matter, a supravaginal hysterectomy was quickly done.

Examination of the growth showed it to be a pear-shaped Fallopian tube with its abdominal ostium closed, the uterine ostium being patent. It was filled with a dirty, bloody liquid, and on section masses of malignant papillomata were found growing from the mucosa.

The patient made a rapid recovery, and was in very good health in May, 1913.

Primary malignant growths of the Fallopian tubes can be said to be rare. They may be uni- or bi-lateral, and at the beginning, if the parametrium is normal, they are generally movable, but adhesions often exist. The growth may be found in the posterior *cul-de-sac*. In many cases very tough adhesions are present, which may be so extensive that removal has been found impossible.

These growths vary in size from that of a small egg to an adult's head. The tube is generally dilated in its external portion and

attached to the uterus by a pedicle. Doran is of the opinion that when the tubal growth is malignant the ostium closes early in the process. There are, however, exceptions to this rule, and the tube may open into a cyst in the ovary. The uterine ostium is often patent, as in the case reported, while the liquid contents continually flow off through the uterus, giving rise to a discharge. This liquid may be quite clear and limpid or, on the other hand, yellowish, purulent, or bloody. It has been found so dark a yellow that one might assume that a large amount of cholesterin was present.

Tubal cancer may give rise to hemorrhage, and clots are sometimes found within the cavity of the tube. On the other hand, in some cases the cavity contains no fluid, being filled by the neoplasm. Whether liquid is present or not, all neoformations of the tubal mucosa present this very important characteristic; namely, they are papillary in nature, this being true of both the malignant and non-malignant adenopapillomata. These can be conveniently divided into three types, which I will consider in detail.

The first of these is the *villous* type. The villosities are, so to speak, planted in the wall of the tube, and are rather long, some being forked at their free extremity. In shape they are usually cylindrical or conical, while others are club-shaped. Their base of implantation is not large, and they are scattered over the surface, giving the latter a velvety look.

The second type is the *papillary* form. This would seem to be a more advanced stage of the former process. This remark, however, is not a positive affirmation, but it is certainly true that in a tube containing villosities one sees, here and there, a tendency to papillomatous transformation, inasmuch as the base of the villosity becomes smaller, while its free end enlarges and divides. On the other hand, in tubes containing a preponderance of papillary growths, few villosities are encountered. It should be mentioned that occasionally the tumor forms true tufts without presenting any tendency toward the papillomatous type.

These papillomata (I am here speaking from the microscopic viewpoint) have generally a very minute base of implantation; the small tumors, which together form the larger growths, are quite independent of each other, and are only closely allied in cases of advanced carcinoma. The neoplasm thus develops toward the external surface

of the tube. The color of the growths is at times yellowish, at others grayish, sometimes a dark red or even bright red, all this depending entirely on the amount of vascularization.

The ovary is often the seat of pathological change, and, according to Doran, it is cystic in 10 per cent. of the cases. Sometimes it is atrophied, at others it is invaded by the neoplasm. The uterus also is sometimes secondarily involved in tubal cancer, its lymph-nodes being filled with malignant cells, and this explains why recurrence takes place in this organ when, at operation, it has appeared to be perfectly normal and free from any malignant change.

The vagina, pelvic peritoneum, omentum, cæcum, rectum, and bladder are occasionally found involved at operation, or evidences of metastases occur after radical procedure. The inguinal glands are sometimes invaded by the malignant cells, but ascites appears to be quite uncommon. In one recorded case (Le Conte, *Johns Hopkins Hospital Bulletin*, March, 1901) the abdominal ostium of the tube was found to be patent, and the ascites appeared to result from peritoneal metastases.

At the commencement of the process, the epithelium presents two forms of proliferation; namely, the papillary and adenopapillary types. In the former variety the cells actively multiply, forming epithelial buds on the surface of the mucosa. In the second stage the epithelial buds, instead of proliferating toward the lumen of the tube, dip into the walls, so that islands of carcinomatous cells anastomosing with each other will be found in the submucosa and underlying layers. In the third stage the cells dip into the interstices of the connective tissue, resulting in the formation of alveola filled with malignant cells.

In the adenopapillary type the epithelium lining the folds of the tubal mucosa has the same pathologic action as the *cul-de-sac* of a gland. It dips into the mucosa, forming cavities lined with cylindrical epithelium which, by proliferation, finally fills them. These proliferations rapidly develop and form anastomoses with each other. Within the walls of the tube the cells distend the interstices of the tissues, and form true alveolæ, so that the final outcome of the process is an alveolar adenopapilloma.

Augier's case reported by Danel (Thesis, Lille, 1899) is that of a tumor in which the epithelium was metatypical in certain areas.

That covering the surface of the papillæ was very irregular and in many layers. In some spots, in the midst of these epithelial cell agglomerations, the cells were arranged in such a way as to circumscribe circular and quite regular spaces, similar to gland tubules. At other points very large cells in a state of colloidal transformation were seen in these cell masses of lining epithelium. Here and there several irregularly polyhedral cells formed nodular clusters pushing aside the surrounding elements, and at these points all characteristics of the epithelium had entirely disappeared and it had assumed the arrangement met with in the most malignant types of carcinoma. Even in those areas where the macroscopic appearance of the tubal mucosa seemed normal, the epithelium was abnormal, forming a complete lining but with variable-shaped cells irregularly distributed in layers. None of the cells appeared to possess cilia.

From these rambling remarks on the pathology of malignant tubal neoplasms it at once becomes clear that nothing short of a hysterectomy is of any avail, and even when this has been done in the apparently early stages of the growth the prognosis is far from good.

Hemorrhagic Appendicitis.—A young unmarried woman, aged 27 years, was seen in consultation February 9, 1909, with the following history: On January 20th the patient had been suddenly seized with severe abdominal pain, more marked on the right side, which was followed by vomiting. On the following day the pain had become pretty well limited to the right iliac fossa, and there was some improvement. Temperature 39° C., pulse 110.

She remained about the same until January 29th, on which day she had such a severe hemorrhage from the bowel as to cause collapse. This occurred again on February 2d and 7th, and the patient's condition became alarming from the anæmia.

Examination on February 9th showed slight jaundice of the conjunctiva, some general abdominal distention, rigidity of the right rectus, and considerable pain on pressure over the cæcal region. Temperature 39.6° C., pulse 125 and weak, respirations 24. Widal reaction negative. A diagnosis of appendicitis was made and operation decided upon, but on account of the weakened state of the patient she was given two injections of 500 Cc. physiological salt solution every 12 hours for the following two days.

Operation February 12th. On opening the abdomen in the right semilunar line the cæcum was found greatly injected, and attached to it was a long, stiff appendix measuring 9 Cc. It was bent at an acute angle at the junction of its lower third with the middle third, and pointed directly into the pelvis. A few thin recent adhesions were broken down and the appendix removed. Abdomen closed without drainage.

The patient made an uneventful recovery, leaving the hospital three weeks later. The intestinal hemorrhage did not recur after removal of the appendix.

Examination of the appendix showed that the lymphoid system of the mucosa was much hypertrophied. There was no evidence of ulceration of the mucosa, but the submucosa was infiltrated by lymphocytes and a few leucocytes. In the bent terminal portion was found some bloody mucus.

The symptomatology of hemorrhagic appendicitis differs in no way from ordinary appendicitis excepting that the stools contain blood or free intestinal hemorrhage occurs. We have then as signs: Pain and muscular rigidity in the right iliac region, vomiting and intestinal hemorrhage, with or without constipation. There is, however, what one might call a particular symptomatology in these cases, to which I desire to call attention, this depending on two factors; namely, intoxication in the first place, and, secondly, intestinal hemorrhage.

When one examines a case of hemorrhagic appendicitis it will be nearly always noted that the usual symptoms are not the ones most in evidence, and that the symptoms of intoxication reign. Palpation of the abdomen is not very painful, and McBurney's point is not distinct. By percussion the liver is found to be enlarged and painful, while the pulse is rapid, and the temperature ranges from 38.5° to 39° C. After the lapse of several days, the patient, who has appeared to be improving, passes blood per rectum. It may come away pure or mixed with the faeces.

Whether there is one large hemorrhage or if it recurs in small quantities upon several occasions, as is more apt to be the case, the symptomatology is that of severe loss of blood. The integuments become pale and the mucosa anæmic, the pulse becomes weak and rapid, cold sweats occur, and later on vertigo leading to collapse, which may end fatally. Occasionally no blood is present in the stools, and still all these signs are present, a condition that may be explained by constipation or by the rapidity with which the intoxication results in early death, so that hemorrhage has not had time to show itself outwardly. Jouteau in his thesis (Paris, 1908) has pointed out that a sudden rise in temperature takes place very soon after the hemorrhage has occurred.

The prognosis of hemorrhagic appendicitis is undoubtedly very grave, not only from the loss of blood, but likewise from the systemic intoxication, of which the former is merely a symptom. The loss of blood is all the more serious in these cases from the fact that there is renal and hepatic insufficiency from the toxæmia. The prognosis,

therefore, depends greatly upon the amount of blood lost and the integrity of the liver and kidneys.

When all the usual symptoms of acute appendicitis are present it is an easy matter to diagnosticate the cause of the intestinal hemorrhage if this takes place; but, unfortunately, the case is not so plain, because, when atypical in character, an appendicitis may simulate all those abdominal affections which are also susceptible of giving rise to hemorrhage as a complication. On the other hand, the hemorrhage may take place independently of appendicitis or coexist with it, which renders the problem more complex.

In order to come to a diagnosis, the following steps must be taken separately: (1) To ascertain if one is really dealing with an appendicitis with hemorrhage, and not with some other hemorrhagic affection; (2) to determine if the blood actually comes from the intestine. In other words, the seat of the loss of blood, likewise the cause, must be looked for. Among the affections for which hemorrhagic appendicitis may be mistaken I would mention acute attacks of mucomembranous enterocolitis, typhoid fever, dysentery, and intestinal tuberculosis.

Mucomembranous enterocolitis frequently accompanies appendicitis, so that a differential diagnosis between these two processes is of the greatest interest. In both there are constipation, pain in the right iliac fossa or over the colon, which both may give rise to intestinal hemorrhage. To differentiate them a careful analysis of the faeces must be made. In mucomembranous enteritis there is no abdominal rigidity; on the contrary, the abdominal wall is lax on account of the enteroptosis, while in appendicitis it is rigid, no matter how little peritoneal reaction there may be.

When appendicitis gives rise to diarrhoea it can be distinguished from dysentery by search for the amoebae or bacilli in the stools. But if the diagnosis is rendered difficult by a condition constantly confronting the medical man,—it is certainly so in differentiating between appendicitis and typhoid fever. All the symptoms are common to both affections,—at least at their commencement,—namely, diarrhoea, pain in the right iliac fossa, abdominal distention, and hemorrhage. Everything appears to point to typhoid, particularly the ambulatory type, and here the laboratory comes to our aid, because it alone can give us an early diagnosis.

Given a patient with a typhoid look and a history of intestinal hemorrhage from the beginning of the illness, it is proper at once to

resort to those tests which we know are pathognomonic of an Eberthian infection (blood examination and serodiagnosis). In typhoid fever there is leucopenia; in appendicitis, leucocytosis.

The differential diagnosis between appendicitis and intestinal tuberculosis, whether it be a tuberculous enteritis or ileocæcal tuberculosis, is an easier matter. Intestinal hemorrhage due to tuberculosis is not common; but when it does take place with appendicular symptoms the real nature of the lesion can be detected by a careful examination of the contents of the right iliac fossa. In these cases one is usually dealing with a chronic hypertrophic tuberculosis which is accessible to direct palpation in the form of an adherent or slightly movable tumor, combined with multiple enlargement of the mesenteric or iliac lymph-nodes. Here, too, blood examination may be of service.

There is another less common affection which should be borne in mind; I refer to ileocæcal invagination; and this particularly when the subject is a young child with abdominal pain, whether localized or not to the right iliac fossa, with rigidity of the abdominal walls, symptoms of peritoneal reaction, and bloody stools.

Remember, also, that a gastroduodenal ulcer with hemorrhage may simulate appendicitis symptomatically, so that one should always be on one's guard. The diagnosis is often a very difficult matter and may, in many cases, be cleared up only by an exploratory incision.

Incomplete Tubal Abortion without Rupture.—On December 12, 1912, I was asked in consultation to see a young married woman, 29 years of age, on account of a uterine hemorrhage which had lasted for several days. In reality it was only a dark-reddish discharge which had made its appearance on December 7th, three days after the regular menstruation was due. Menstruation had last taken place on November 6th; it had always occurred regularly every four weeks, and, although married for six years, the patient had never been pregnant. She complained also of slight pain in the lower abdomen, but otherwise felt perfectly well.

Abdominal examination showed that the walls were relaxed excepting over the left iliac fossa, where there was marked abdominal rigidity and where pain could be elicited. Bimanual examination revealed an oval mass in the left iliac fossa about the size of a large plum. The uterus was in normal position, the fundus just reaching the pubis. The cervix was somewhat softened and the os patulous. The left lateral *cul-de-sac* was tender and offered resistance to the exploring finger. The posterior and right lateral *culs-de-sac* were free.

Upon surveying the situation I came to the natural conclusion that the case was one of early pregnancy, probably extra-uterine in nature, but, in order to be positive, thought it wise to wait and examine the patient a few days later. In the meantime she was ordered to remain quietly in bed and to have the discharge carefully examined for any evidence of membrane. Three days later, after a few colicky pains, a fairly good-sized bit of membrane was passed.

As all doubts concerning the diagnosis were now removed, the patient entered a private hospital. On the following day (December 14th) the condition of the left iliac fossa was as follows: A distinct and very tender mass could be made out, decidedly pasty to the touch, both the posterior and right lateral *culs-de-sac* being perfectly free and painless.

On December 16th the abdomen was opened in the median line, and, much to our surprise, upon exposing the peritoneum it was found to be dark blue in color, evidently indicating a collection of blood in the abdominal cavity. When the peritoneum was incised a hemorrhagic focus was revealed composed of a mass of small clots, for the most part organized, and a small amount of liquid blood. The blood and clots were first removed, then the left tube, which was slightly adherent to the broad ligament, was freed and removed. A small cigarette drain was inserted, and the abdominal incision closed in three layers. The convalescence was uneventful, the patient leaving the clinic two weeks later.

Examination of the tube showed that its cavity was perfectly normal excepting in the region of the pavilion, whose fringes were thickened, infiltrated, and covered with fibrinous deposits which together with the ovary, which had also been removed with the tube, formed the seat of the ovarian graft and point of detachment of the ovum.

When we take into consideration the intermediary forms between rupture of the tube and complete tubal abortion without rupture, an early diagnosis is necessary in order that we may act promptly. The diagnosis of sudden rupture in a tubal pregnancy need not concern us here, as the story has been told many times; but the difficulty increases when it becomes necessary to make a differential diagnosis between incomplete tubal abortion and incomplete or even complete uterine abortion. Both cases (detachment of the uterine or tubal ovum) produce similar symptoms; namely, irregularity of the menses, bloody vaginal discharge, vertigo, pain in the abdomen, and progressive anaemia.

To differentiate these two forms of abortion, it is necessary carefully to observe the *nature* of the blood passed *per vaginam*. In ordinary miscarriage the metrorrhagia is profuse and intermittent, the intervals are rather long, and until the ovum is expelled the hemorrhage is real. But blood alone is not expelled, for along with it come bits of membrane and clots.

In incomplete tubal abortion things are quite different. The blood passed *per vaginam* is much less in quantity, the flow is continuous and almost regular, but from time to time it presents variations in amount, the increase of the intermittent discharge corresponding to the detachment of the ovum in the tube as the process progresses. A few whitish membranes may come away, but there are never large

clots. The blood is not so bright a red as in uterine abortion, usually being of a typical rusty color.

Pain is more intense in incomplete tubal abortion, excepting when there is rupture of the tube, and it is localized distinctly in one of the pelvic fossæ. There a tumor slowly develops which, when due to an haematocele, is semisolid to the feel. But what is all-important for the diagnosis is the increase in size of the mass from time to time, and this corresponds with the paroxysms of pelvic pain complained of by the patient and the appearance of metrorrhagia.

At the time a rupture of the tube takes place, the amount of anaemia can rarely be exactly estimated. The clinical syndrome is composed in these cases of symptoms of frank acute anaemia, due to the amount of blood which has escaped into the abdominal cavity, and the symptoms of shock due to pain and peritoneal reaction. Therefore, there is every indication for the administration of morphine, which will control some of the effects of the shock and allow the surgeon to estimate the degree of anaemia, likewise to consider the question of subsequent or immediate surgical interference.

Given the gravity of the situation arising from the size of the haematocele, the progressively increasing anaemia, and the peritoneal reaction, surgical interference is clearly indicated, and should be resorted to as soon as a diagnosis has been made. By laparotomy the clots and blood are removed, likewise the ovum and everything attached to it; consequently the tube and its contents should be removed *in toto*, as I do not believe in conservative surgery in these cases, even if the tube appears otherwise healthy.

Postoperative complications are infrequent. As an anaesthetic I prefer ether given by the drop method. Ether counteracts the phenomena of shock and raises the blood-pressure.

Meningeal Hemorrhage in the Newly-Born Infant.—Primipara, aged 29 years, the wife of a physician, on May 11, 1911, gave birth to a girl weighing seven pounds and a half. Labor was long and difficult owing to rupture of the membranes early in its progress, and also on account of the large size of the fetal head. After 16 hours, the head no longer advancing to the perineum, the forceps were applied and the child was delivered at five in the morning.

The child began to breathe without difficulty, although the cord encircled its neck twice, and its face was quite black from venous stasis. It remained quiet and as if in a state of stupor all day, but in the evening was seized with convulsions. The paroxysm was repeated at about midnight, and from then on the attacks became more and more frequent, the convulsions being general, but perhaps more marked in the upper extremities and face.

We saw the child at 8 A.M. on the following day. Examination showed a well-formed female infant in evident stupor; pupils equal and reacting to light. Pulse 138, respirations 39. An almost continuous spasmoid contraction of the arms and hands, less marked in the lower extremities. Fontanels bulging with absence of pulsation. A diagnosis of meningeal hemorrhage was so obvious that lumbar puncture was omitted and surgical interference resorted to at once. After the ordinary preparation of the field of operation, an elastic ligature was lightly applied, and a short incision was made over the anterior fontanel, which was particularly bulging and dark-colored. A large needle was then introduced, which gave issue to a few drops of blood; but, as this was insufficient, an incision 2 cm. long was made over the left coronary suture and the dura mater incised, giving issue to about 15 Cc. of dark blood. The same procedure followed on the right side, but only about 5 Cc. of blood came away.

At the end of the operation, which was done without anæsthesia, the child began to be restless and cried. A small drain was inserted and the incisions closed with bronze-aluminum sutures.

After the operation the convulsive paroxysms entirely ceased, and the child progressed quite well. The sutures were removed on the fifth day, union *per primam* having taken place. We saw the infant in April, 1912, at which time she had developed into a healthy child, although, perhaps, not quite of the ordinary intelligence. There was no paresis of the limbs, and she was beginning to stand on her legs.

Until within the last few years the treatment of meningeal hemorrhage in the newborn had been purely medical, and naturally the results were disastrous, but surgery at last lent its aid. Lumbar puncture was first put to trial, and certainly its value is now beyond question. But this operation has been the cause of some mishaps, hence the technic must be properly attended to.

The infant should be placed on the side and the spine made to project as much as possible so that the intervertebral spaces become slightly accentuated. Although in infants the space separating the vertebral blades and the spinous apophyses is relatively small, this is largely compensated by the slight development of these bony structures. The cord in the infant descends farther than in the adult, but not lower than the third lumbar vertebra, and it can be avoided by inserting the needle in the fourth lumbar space. The sheath containing the cerebrospinal fluid ends with the dural *cul-de-sac* at the level of the second sacral vertebra. The fluid should be allowed to run out, never aspirated, as this would cause a sudden decompression resulting in *an intracerebral hemorrhage*.

On account of the rapid reproduction of the cerebrospinal fluid in infants, particularly under the irritating action of a collection of blood, it should be allowed to flow off by the needle. As much as

10 or 15 Cc. can be removed without hesitation, and puncture can be repeated a number of times should signs of cerebral pressure continue to exist. When there is hemorrhage the cerebrospinal fluid is uniformly tinged yellow or pink, sometimes greenish when the hemorrhage is not recent, and, above all, it *must not coagulate*. It is by these two signs that a diagnosis can be made when a microscope is not at hand.

As a therapeutic measure lumbar puncture has been a failure, and other means have been devised in order to remove the offending clots from the cerebral surface; for it is now a well-known fact that in the newborn the blood coagulates very quickly in the subarachnoid space, and when this is opened large clots will always be found. Lumbar puncture has proved this, because on the fourth day the cerebrospinal fluid was hemorrhagic, and on the eighth was perfectly limpid in a case recorded by Devraigne (*Presse Médicale*, August 16, 1905).

In 1905, Cushing, then of Baltimore, proposed and resorted to free surgical interference. He operated on nine infants with four successful results and five deaths. In justice it should be said that he operated from the second to the twelfth day following birth, in two cases he did a bilateral operation, and twice a secondary.

Cushing's technic is very simple. The parietal is exposed by a free horseshoe-shaped incision of the scalp, following the edges of the bone. The periosteum is next peeled off, then the fibrous tissue of the fontanels is cut with scissors around the parietal, which is then forcibly broken at its base and reflected backward. Thus the dura is extensively exposed; it will be found black and motionless. It is then incised, giving issue to blood and clots, after which the subarachnoid space is gently irrigated with salt solution in order to clean it out as well as possible. The elastic band around the head is now removed so as to diminish the blood-pressure as much as possible, and the dura and integuments are closed with sutures. If the hemorrhage is bilateral, the tension on the opposite side may cause hernia of the brain on the side of operation, and thus prevent closure of the wound. Under these circumstances the other side must be operated on, this having been required in three out of nine of Cushing's cases.

Cushing's technic has been followed by Meara and Taylor with one fatal case; Hubbard, one fatal case; Murphy, three cases with two deaths; and Seitz, one fatal case. This gives a total of 15 cases with

nine deaths; in other words, a mortality of 60 per cent.—a figure not really encouraging! Seitz's technic differs somewhat from that of Cushing inasmuch as he incises the scalp, some distance from the median line, from the coronary suture to the lamboïd suture and parallel with the sagittal suture. The scalp is then dissected off and the underlying bone cut with a knife to the dura mater, and the latter peeled off. Then, at each end of the opening in the skull and perpendicular to the first, two more incisions are made in the bone by passing the scissors between the detached dura mater and the skull. With a blunt instrument the detachment of the dura is continued to the parietal protuberance, after which, on account of the fetal elasticity of the cranial bones, the parietal is everted by pressure with the thumbs over the parietal protuberance. The dura is then incised as far down as possible by a transversal incision and the clots removed. Traumatism and shock must be quite as considerable with this technic as with that of Cushing.

Simmons, of Boston, believing rightly that in these moribund infants traumatism should be reduced to the minimum, reaches the dura by way of the parietals. A small incision of from two to two and a half centimetres is made, following the upper border of the parietal,—in other words, directly over the usual seat of the hemorrhagic focus,—and the dura is opened. After the blood has been let out, the incision is closed. In a way this technic is not so complete, because the clots may not all be removed, but the operation is clearly a minor one; in both cases operated on by Simmons recovery ensued, as also in my case here recorded.

It is evident that by Cushing's method the chance of future organization of a clot is done away with or is very slight, and some infants have recovered; but the operation is a very serious undertaking, and should not be entered upon lightly. The only danger in Simmons's operation is the possibility of tearing the cerebral substance, which is soft and under great tension, but with care the competent operator can avoid this. The all-important point is to give exit to the blood as quickly as possible. If at a later date paralyses or epileptiform symptoms appear, the child being more developed and having greater powers of resistance to withstand a major operation, this is the opportune moment for resorting to the more formidable operations for the cure of the lesions which cause the late cerebral symptoms.

INTERESTING SURGICAL CASES

BY P. G. SKILLERN, JR., M.D.

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CARCINOMATOUS DEGENERATION OF SEBACEOUS CYST

CASE I.—E. R., female, aged 55 years, married, presented in the Surgical Out-Patient Department of the University Hospital (case-record 38981), October 30, 1913, with a lobulated tumor on the middle of the front of the scalp, just above the hair line, and the size of a silver dollar. There were numerous wens elsewhere in the scalp.

Under novocain-suprarenin anaesthesia the tumor was cut into, and proved to be solid, but studded with small cysts. It bled profusely. Clinically, it corresponded to a sebaceous cyst that had undergone malignant degeneration. A piece was therefore excised, bottled in formalin, and sent to the Laboratory of Surgical Pathology. The following was reported by Dr. John Speese: "Macroscopically, the external surface is covered by skin from which project numerous dark-brownish hairs. The underlying tissue consists of fibrous trabeculae separating numerous cystic cavities, the latter being filled with yellowish, somewhat friable, soft contents. Microscopically, the tissue consists of a connective-tissue stroma, moderately rich in cells and containing numerous large *irregular* islands of squamous epithelium, showing pearly body formation with much central necrosis."

The lesson to be learned from this case is superlatively important, since it confirms the modern principle of *attacking cancer before it is cancer*, as inculcated by Deaver, Rodman, Bloodgood, and others. Since this statement appears paradoxical, it may be expressed in another way. Primary carcinoma begins, in the large majority of cases, in a patch of epithelium which has been disturbed by inflammation, usually of the chronic type, or by benign neoplastic growth. The time comes when something occurs that stimulates this crippled epithelium to exuberant and riotous growth, in the course of which it bursts through its normal limiting membrane and trespasses upon the tissues beyond, just as when an engine, deprived of its governor, races. The slumbering epithelium has awakened as a raging cancer. To steal this epithelium while it sleeps is the aim of the alert surgeon. Therefore, *the only "sure cure" for cancer is to prevent it by re-*

moving precancerous foci. This includes seborrhœic keratoses, sebaceous cysts, warts, nævi, pigmented moles; to cure chronic ulcers, whether in the stomach or on the leg; to repair tears, as of the cervix uteri; and to substitute linear for spreading scars or for cheloids, when possible. All such precancerous foci should be subjected to microscopic scrutiny for the beginnings of cancer, for in a large series there must be some that will show the transition.

LINEAR ULCER OF MOUTH: EPITHELIOMA

CASE II.—W. N., male, white, aged 64 years, farmer, single, presented in the Surgical Out-Patient Department of the University Hospital (case-record 39597), January 19, 1914, with a linear crack, three-eighths inch long by one-sixteenth deep, on the oral surface of the left angle of the mouth; duration, seven months. There was no induration about it. Wassermann reaction negative. Under novocain-suprarenin anæsthesia the lesion was excised and sent to the Laboratory of Surgical Pathology. Dr. Speese described the specimen microscopically as "consisting of an epithelial border covering a mass of connective tissue of varying density, between the fibres of which are several areas of round-cell infiltration, and deeply situated are several islands of squamous epithelial cells arranged in the form of branching processes and pearly bodies." Thus the clinical diagnosis of carcinoma, which was made by Prof. M. B. Hartzell, by whom the patient was referred, was confirmed by microscopic examination.

Here we are dealing with a very early carcinoma developing upon the basis, in all likelihood, of a tooth laceration of the cheek, which is not uncommon in this situation. The malignant ulcer was ablated in a stage just a little beyond the precancerous. It substantiates the comments made in discussing the previous case, in that there was a time when the lesion could have been excised when a simple ulcer,—i.e., during the precancerous period. That the simple ulcer did not heal may be accounted for by repetition of the dental trauma and the absence of physiological rest. Small though it was, yet the results of the lesion may still be disastrous, since six weeks before the patient applied for treatment he noticed for the first time what proved to be enlargement of the submaxillary lymph-nodes on the left side—a complication that renders the prognosis very guarded. The malignant nature of the ulcer having been determined, the patient was sent into the surgical ward for ablation of the enlarged lymph-nodes. Whether these proved to be depositories of metastatic cancer my notes do not state, but this must always be considered a very important point in the prognosis.

Finally, it is to be noted that the Wassermann reaction was negative. This test was made not because the lesion was deemed to be specific, but because it has been established that numerous malignant ulcers about the mouth, and particularly on the tongue, develop upon the basis of preexisting *gummata*. Hence the recognition and cure of oral syphilis must be reckoned among the precancerous therapeutic measures.

**LYMPHATIC LEUKÆMIA: EXCISION OF LYMPH-NODE FOR
DIAGNOSTIC PURPOSES**

CASE III.—A. F., male, white, aged 57 years, fireman, married, reported at the Surgical Out-Patient Department of the University Hospital (case-record 39424), December 27, 1913, having been referred from the Medical Out-Patient Department to have a lymph-node excised for microscopical examination, the clinical diagnosis being lymphatic leukæmia. Under novocain-suprarenin anæsthesia a lymph-node of the posterior superficial cervical chain, just behind the external jugular vein, was ablated, bottled in formalin, and sent to the Laboratory of Surgical Pathology. Dr. Speese reported as follows: "Histologically, the lymph-node contains an abnormal number of normal lymphoid cells, these being closely packed together, forming an almost solid mass. Diagnosis, lymphatic leukæmia."

Irrespective of the clinical history and the blood-picture in this case, we wish to emphasize the value of this method of diagnosis in disease affecting the cervical lymph-nodes. These structures are the dumping-ground for all sorts of refuse in the areas which they drain, be the primary focus a bacterial infection or a neoplastic formation. A mere study of the anatomy of the lymphatic system of the neck in conjunction with its applied pathology suffices to show the numerous possibilities, and, while a correct clinical diagnosis may be realized in the majority of cases, yet there are many puzzling situations that can be cleared up only by the microscopical examination of an ablated lymph-node. This method is simple, rational, harmless, and convincing. It will be the cause of many surprises being sprung upon even the most astute clinicians. But it must be remembered that in most cases the whole story is not told until the primary focus has been discovered, for it is to this that therapeutic measures must usually be directed in order to bring about healing of the lymph-node. In the acute infections the diagnosis is usually not difficult; in the chronic, as tuberculosis, it is more difficult; while in metastasizing neoplasms it may be most difficult, for here the primary focus may

be intracranial, as a sarcoma of the dura mater; intrathoracic, as a mediastinal neoplasm; and intra-abdominal, as a carcinoma of the stomach. It is always a good plan to look beyond the cervical area, and to examine the lymph-nodes in the axillæ and in the groins.

SUBACROMIAL BURSITIS CASTING SHADOW IN SKIAGRAM

CASE IV.—M. D., male, white, aged 55 years, painter, married, presented at the Surgical Out-Patient Department of the University Hospital (case-record 39861), February 19, 1914, having been referred from the Nervous Out-Patient Department by Dr. A. R. Allen. For three months he had been complaining of pain in the right shoulder, which was worse at night. He could not use the arm. Clinical examination revealed marked tenderness over the greater tuberosity of the humerus, and pain which was increased by abduction beyond 10 degrees. The skiagram (Fig. 1) showed a distinct exudate in the subacromial bursa. The day after admission a fly-blister was applied over the painful area. One week later the motions of the arm were complete and painless, and there was very little pain in the absence of motion. He was discharged cured.

Subacromial bursitis (*Fibrosis bursæ subacromialis*) was discussed by the writer in these columns last year.¹ Nevertheless it will bear repetition, because it often escapes recognition as a common cause of disability of the shoulder-joint. In my experience every large joint presents a characteristic disabling lesion as the result of trauma—a lesion that remains obscure and indefinite because of the absence of gross signs, and yet one that may usually be recognized by a knowledge, first, of the mechanism by which the injury was produced, and, secondly, of the sign-complex, which usually possesses certain pathognomonic features. A list of such lesions includes, for the ankle-joint, a fracture of the lower end of the fibula without displacement; for the knee, a tear of the meniscus (fracture or luxation of the semilunar cartilage); for the hip, perforating fracture of the acetabulum; for the sacro-iliac joint, strain; for the wrist, fracture of the scaphoid bone; for the elbow, epicondylitis or tennis-elbow; and for the shoulder, subacromial bursitis.

Subacromial bursitis has been discussed recently by Littig,² who quotes Codman as saying that it is usually diagnosed as "brachial neuritis, peri-arthritis, muscular rheumatism, circumflex paralysis, contusion of the shoulder, fibrous gout, rheumatism," etc. His con-

¹ INTERNATIONAL CLINICS, 23d Series, vol. iii, 205.

² Jour. A. M. A., 1914, lxii, 907.

clusions are quite in accord with the views I expressed in the article referred to above, and are summed up as follows:

1. Subacromial bursitis is a very frequent cause of shoulder-joint disability.
2. It is caused by traumatism or by sepsis.
3. In the first stage abduction and rotation are limited by muscle spasm.
4. In the second stage abduction and rotation are limited by adhesions.
5. In the third stage, when adhesions have been sufficiently stretched or dissolved, movement may be relatively or entirely unimpeded.
6. The bursa may be distended with fluid, and limit abduction by being caught between the tuberosity of the humerus and the overhanging acromion.
7. Treatment: In the first stage, rest; in the second stage, persistent but mild stretching of adhesions; in the third stage, continuation of movement, with possible excision of the bursa. At any stage, a bursa distended with fluid may be evacuated.

Believing that the most important feature of the treatment in the acute stage had been omitted from Littig's conclusions, the author wrote an article entitled: "The Blister Treatment of Subacromial Bursitis," which was published in the *Jour. A. M. A.*, 1914, lxii, 1111.

ACUTE TENDOSYNOVITIS OF EXTENSORS OF FINGERS (TENDOSYNOVITIS
MM. EXTENS. DIGITORUM COMMUNES)

CASE V.—J. T., male, white, aged 45, painter, single, reported at the Surgical Out-Patient Department of the University Hospital (case-record 39953), March 3, 1914, with the statement that three weeks previously, while "talking" with his fingers (he is a deaf-mute), he accidentally struck the dorsum of the right hand against a flower-pot. Examination revealed the characteristic leathery crepitation, very similar to "crunching" of freshly-fallen snow underfoot. A cantharides blister was applied and the hand put at rest on a splint. The next day a large blister had formed and the crepitation had disappeared. The splint was removed. Five days later the patient was discharged cured.

In this patient, a deaf-mute, rapid restoration of function was of paramount importance. As in subacromial bursitis, here, too, the blister treatment is the most efficacious, and it is doubtful whether any other method would have restored function so rapidly. Surely,

Subacromial bursitis. Note shadow cast by exudate.
(See Case IV.)



FIG. 1.

FIG. 2.

FIG. 3.

Fracture of radius and ulna, shafts. Position of bones immediately after injury.
Anteroposterior view. (See Case VI.)



Lateral view of preceding figure.



FIG. 4.



Fracture of radius and ulna, shafts. Bowing of ulna partially corrected, fragment of radius automatically shifting into place. Greenstick fracture of ulna, however, not entirely converted into complete. Anteroposterior view. (See Case V.)

FIG. 5.



Lateral view of preceding figure. In obtaining a better lateral reduction the bones were displaced more to the dorsum. Shows importance of taking skiagrams from two aspects.

the old method of ichthyl and splint would have proved a great disappointment in this case.

Other situations in which tendosynovitis is not infrequently seen are in the sheaths of the long extensor muscle of the toes, just above the ankle, and in the retromalleolar portion of the sheaths of the peronei muscles. I am still seeing cases of tendosynovitis at the wrist mistaken for Colles's fracture.

FRACTURE OF RADIUS AND URNA, SHAFTS ; REDUCTION BY DEGREES

CASE VI.—H. H., male, white, aged 14 years, schoolboy, presented at the Surgical Out-Patient Department of the University Hospital (case-record 40201), April 2, 1914, with the history of having fallen, two days previously, while roller-skating, injuring the right forearm. Skiagram (Fig. 2) showed in the antero-posterior view for the radius an oblique line of fracture one inch above the epiphyseal cartilage, with the lower fragment shifted laterally one-third of a diameter; and in the lateral view (Fig. 3) the lower fragment of the radius displaced dorsally two-thirds of a diameter. The ulna showed in the antero-posterior view a greenstick line which was incomplete externally, with bowing of the ulna so that the concavity presented externally.

There are several features of interest in this case. In the first instance it is evident from the skiagram that the brunt of the force was borne by the radius, whose fracture is complete, and that there was sufficient force remaining to produce the greenstick fracture of the ulna. After rupturing the inner fibres of the ulna and compressing the outer, the force stopped short of causing a complete fracture of this bone. The intact outer fibres of the ulna maintained the position the bones were in when the force ceased to act, and therefore presented the chief obstacle to reduction. From a study of the skiagram it is patent that in order to reduce the fracture attention must be directed chiefly toward overcoming the vicious bowing of the ulna, and that this could be accomplished only by rupturing the intact outer fibres, which means conversion of the greenstick into a complete fracture. This having been done, the radial fragments, aided by a little pressure, would almost take care of themselves. The accompanying series of skiograms (Figs. 4 to 11) shows that, by following this plan, complete reduction of the fragments was ultimately attained. A total of five attempts at reduction was necessary. The fluoroscope could have been used; but it would not have furnished permanent records.

A very similar case, except that the fracture of the ulna was complete, was illustrated and described by the writer in INTERNATIONAL CLINICS, 23d Series, vol. iv, p. 238. The alternatives of "nursing" the fragments into place are two in number, and it is to be regretted that one or other is frequently employed. The first is to work without the aid of the X-rays or fluoroscope, which, of course, is usually unavoidable; or, if the rays are employed, to fail to have another picture taken to show the extent of reduction; or failure to persist in further attempts. The second is to become frightened at the appearance of the fragments in the skiagram and forthwith to perform open reduction and plating. I am quite in accord with the views expressed by Ashhurst and John, whose paper I quoted in the article referred to above. The lesson this paper teaches is that "a fairly large series of cases of fracture of the forearm, involving both bones *in some part of their shafts*, may be treated with satisfactory results *without a single resort to operation*," and that this is the type most often, "and usually quite unnecessarily," subjected to operation. I consider the teaching that a bad anatomical result does not always imply a bad functional result to be baneful, for it furnishes an excuse to be satisfied with inferior anatomical reduction. On the contrary, I agree with the idea expressed by Mr. Robert Jones, of Liverpool, who stated that a bad anatomical result gives good functioning in only 29.7 per cent., but that a good anatomical result gives good functioning in 90.7 per cent. The same authority also advises that, in addition, the bones be restored to their normal curve.

The final point of interest in this case is the separation of the styloid process from the remainder of the lower epiphysis of the ulna. Fractures of epiphyses are much neglected in the literature, but the writer recently reported two cases.³

CHRONIC FOCAL OSTEOMYELITIS OF THE BASE OF THE FIRST METACARPAL

CASE VII.—M. J., female, white, aged 61 years, single, cook, reported at the Surgical Out-Patient Department of the University Hospital (case-record 40013), March 11, 1914, with the history of an injury sixteen months previously to the base of the first metacarpal bone of the right hand. Since then there has been pain, which has gradually increased in severity. Clinically, there was localized tenderness similar to that elicited in fracture, but not quite so severe, or "winc-

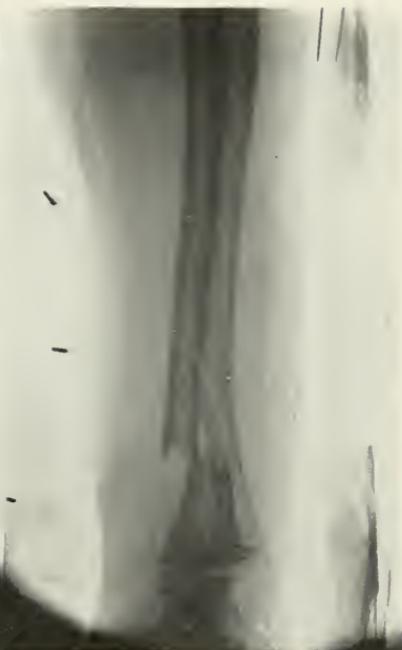
³ *Annals of Surgery*, 1914, l ix, 445.

FIG. 6.



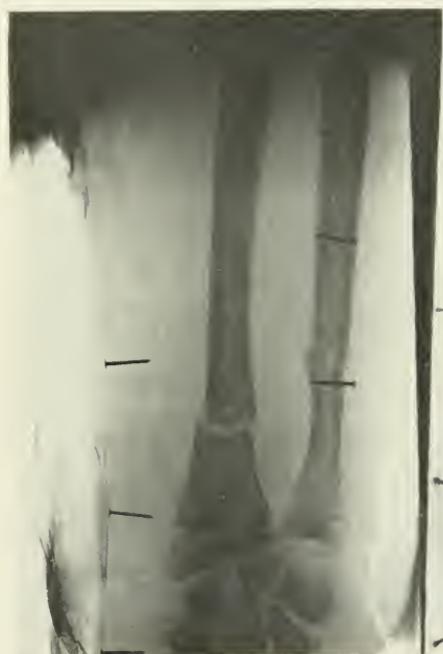
Fracture of radius and ulna, shafts. Bowing of ulna entirely corrected. Greenstick fracture of ulna converted into complete. Bones in perfect alignment, and with restoration of their normal curves. Anteroposterior view. (See Case VI.)

FIG. 7.



Lateral view of preceding figure. Inferior fragment of radius being lowered from its high dorsal position.

FIG. 8.



Fracture of radius and ulna, shafts. Position after third attempt at reduction. Alignment of bones still preserved. Note fracture of styloid constituent of lower epiphysis of ulna. Anteroposterior view. (See Case VI.)

FIG. 9.



Lateral view of preceding figure. Inferior fragment of radius approaching its normal position, but not yet completely reduced.

FIG. 10.



Fracture of radius and ulna, shafts. Position after final attempt at reduction. Alignment of radius and ulna not perfect, but satisfactory. Anteroposterior view. (See Case VI.)

FIG. 11.



Lateral view of preceding figure. Inferior fragment of radius finally "home."

ing." There were no other signs of inflammation. Skiagram (Fig. 12) revealed a cavity the size of a pea at the ulnar corner of the base of the first metacarpal bone. Under nitrous oxide anaesthesia an incision was made along the ulnar border of the base of the metacarpal bone. Carefully avoiding the tendon of the extensor pollicis longus and the carpo-metacarpal joint, which was hard by, the cavity was readily entered with a chisel and was curetted, granulations with a drop of pus being evacuated. The cavity was packed with iodoform gauze and a dressing and a splint applied. Upon her return the next day the patient stated that she had been free from the boring pain for the first time in sixteen months. On discharge, two weeks later, the wound was all but healed.

In the preceding number of *INTERNATIONAL CLINICS* (24th Series, vol. i) the writer illustrated and described two cases of Brodie's abscess of the tibia. The pathology of the lesion in the present case is not dissimilar, but is on a smaller scale.

WARTS OF FINGER; RADIUM THERAPY; CURE

CASE VIII.—S. M., male, white, aged 21 years, single, student, presented at the Surgical Out-Patient Department of the University Hospital (case-record 39715), February 2, 1914, with a sessile wart the size of a pea on the ulnar border of the distal interphalangeal joint of the middle finger of the right hand, of one year's duration. There was also a smaller wart on the same finger, but a little higher up. A capsule containing ten milligrammes of radium chloride was applied to the larger wart for a period of half an hour. The smaller wart was untreated. At the next visit, nine days later, the wart had diminished in size. The radium was again applied, this time for a period of fifty-five minutes. Six days later the wart fell off, and no trace of a scar remained. *At the same time the smaller wart, though untreated, disappeared.*

Warts treated by desiccation with the high-frequency current have been illustrated and described in these columns previously.⁴ One application of the spark usually sufficed to bring about cure. The objections to this method, in comparison with radium, are that it is painful, usually requiring subdermic anaesthesia; it is annoying to nervous patients and children; and, unless care be exercised, an electric burn may result. Radium, on the other hand, works subtly, silently, and painlessly; is, indeed, the amulet *par excellence*. A scar after the use of radium either does not exist or is conspicuously insignificant. On the contrary, radium reduces the size of pre-existing scars, and is an excellent cure for cheloids. It also cures nævi and pigmented moles. Indeed, it fulfils the indication of an ideal drug, since it acts *cite, tute et jocunde.*

⁴ *INTERNATIONAL CLINICS*, 23d Series, vol. iii, 209; 23d Series, vol. iv, 244.

UNILATERAL GYNÆCOMASTIA

CASE IX.—A white male, aged 19 years, single, student, reported at the Surgical Out-Patient Department of the University Hospital (case-record 39964), March 4, 1914, with the statement that for the past two years he has noticed a gradual enlargement of the left breast, and that as the result of conversation with some medical students he feared he was getting a cancer. Examination revealed no neoplasm, but a well-developed left breast, corresponding to that of a 16-year-old girl (Fig. 13). The right breast, the genitalia, and the sexual instincts were wholly masculine.

This condition is very rare. Köster⁵ reported a similar case in a boy 16 years of age. "The left breast possesses a prominent feminine nipple with a wide areola. The right nipple is also larger than that of a grown man. On palpation no glandular structure is felt on the right side, while on the left a well-developed breast the size of that of a 16-year-old girl is present. The young man is otherwise quite normal, with normally developed genitals and sexual instincts."

A very interesting case was reported by Shufeldt.⁶ It was observed by Mr. Nible, a well-known traveller and lecturer, in the person of one Chengwayo, chief of Zulus, who was 55 years of age, 6 feet tall, and of about 400 pounds weight. He has married over 40 wives, and is the father of more than 100 children. It is supposed that he nursed some of them. The genitals are entirely male, fully functional and active. He has male instincts, and there is no sexual perversion. The children are normal. The picture shows remarkably large breasts.

The writer is indebted to Dr. J. Leon Herman for supplying these references.

LUXATION OF ENSIFORM PROCESS OF STERNUM

CASE X.—J. L., male, white, aged 23 years, single, tailor, reported at the Surgical Out-Patient Department of the University Hospital (case-record 40259), April 9, 1914, with the history of having fallen six months previously flat on his chest on a diving-board. Since then he has suffered from pain in the epigastrium, which was worse when bending forward. Examination showed that the cartilage was forced inward, there being a depression at its normal location. He was admitted to the surgical ward to have the cartilage elevated.

⁵ *Deutsch. med. Woch.*, 1905, lii, 725.

⁶ *Med. Council*, 1910, 244.

FIG. 12.



Chronic focal osteomyelitis of the base of the first metacarpal. Note paranasal cavity at ulnar corner of base. (See Case VII.)

FIG. 13.



Unilateral gynecomastia. Note enlargement of left breast and areola. Right breast normal. (See Case IX.)

FIG. 14.



Fissure fracture of internal condyle of femur. (See Case XIII.)

FIG. 15.



Vertical fracture of external tuberosity of tibia. But for the "wincing" tenderness this might have passed clinically for a contusion. Anteroposterior view. (See Case XIII.)

FIG. 16.



FIG. 17.



Fracture of inferior epiphysis of tibia. Lateral view of preceding figure. Injury does not show. An injury to which but slight, if any, attention has been called. Anteroposterior view. (See Case XIV.)

This injury is very rare. Malgaigne, cited by Agnew,⁷ has collected two cases. "In both the displacement was caused by force directly applied to the epigastrium; and in both the injury was followed by severe pain in the region of the stomach, and by difficult respiration and vomiting, which were only removed by the reduction of the cartilage. This was effected, in one of the cases, by pressing the finger beneath the cartilage and raising it into position. In the other case reduction was effected by dividing the overlying tissues, including the peritoneum, along the side of the cartilage, and then hooking it into place." Agnew believed that the dyspnea was due to irritation of one or both of the phrenic nerves. With this view I cannot agree, since the cartilage is situated in the midline, between the two nerves and distal to their terminations. It is more likely due to interference with the sternal fibres of the diaphragm, and the vomiting and pain to irritation of the peritoneum and pressure upon the liver.

Skiagram, of course, would fail to reveal the displaced cartilage, unless it were ossified. The symptoms disappeared after operation.

A lesion in this region that often causes pain and vomiting, and one that is often overlooked, is epigastric hernia. In this condition an annular orifice is found in the linea alba between the ensiform and the navel, usually about midway. Through this orifice a pellet of preperitoneal fat usually protrudes, and at times the wall of the stomach is nipped.

Another similar lesion of this region is diaphragmatic hernia, a case of which was illustrated and described by the writer in the preceding number of *INTERNATIONAL CLINICS* (24th Series, vol. i).

TOXIC MYOSITIS OF ERECTOR SPINÆ MUSCLE

CASE XI.—A. G., male, white, aged 22 years, single, fireman, reported at the Surgical Out-Patient Department of the University Hospital (case-record 39623), January 21, 1914, with the history of having arisen a few days previously with pain in the back, which compelled him to adopt a bent attitude. Attempts at straightening up made the pain worse; in fact, the more he bent over, the more relief he felt. Examination revealed tenderness of the erector spinæ muscle of the right side. The patient was wet-cupped freely, over an ounce of blood being removed. At the conclusion of the operation the patient could straighten his back without difficulty and without pain.

⁷ *Surgery*, 1881, ii, 40.

Provided a correct diagnosis has been made, there is no treatment that gives such instantaneous relief as wet-cupping in toxic and in certain forms of traumatic myositis.

To slur over a patient complaining of backache may be fraught with great danger. Not that it is my intention to enumerate the various causes of pain in the back: they are legion; but for some reason, because the pain is in the *back*, it is not scrutinized so carefully as pain in the *abdomen*. I referred to this subject previously in these columns,⁸ by stating that "every backache has a definite cause, which may be toxic, static, or reflex, and every backache, which is too frequently dismissed as 'lumbago,' which means nothing at all, should be investigated by history and by physical examination with as much care as an obscure affection in the upper abdominal zone. A case which was almost dismissed in this trivial manner proved to be a perinephric abscess."

An excellent analysis of the subject has recently been written by Morley,⁹ and it shows the possibilities of injuries of the back, calling a spade a spade, instead of generalizing under the term "sprain." The structures that may be involved are the muscles, the fascias, the various ligaments, the joints between the articular processes, the intervertebral discs, the spinal cord, and the nerves. He writes:

"If a muscle of the back is torn or bruised, there is the same localized pain and tenderness over it as there is in the case of a muscle of a limb that has been similarly damaged. This pain is increased by passive stretching of the muscle, or by active attempts to contract it. If torn completely across, there will be immediate loss of power in that muscle; if superficial, a gap can be felt in the early days. The point of greatest tenderness will be over the tear, and constant in position. In lifting efforts the torn muscle will be most likely the erector spinae or one of its upward prolongations, and pain will be definitely increased by attempts of patient to straighten spine, or by passive attempts to bend it. If the latissimus dorsi has been torn or injured, the movements which produce pain are those of raising the corresponding arm or drawing it or the shoulder backward. Being a comparatively superficial muscle, its injury or rupture necessarily gives rise to fairly definite local swelling and ecchymosis at first.

"The lumbar fascia, like the erector spinae, is liable to be torn in violent efforts to extend the spine, as in lifting heavy weights. Where the lumbar fascia is strained or torn there will be naturally a point of maximum tenderness and pain. *Such a maximum point is not to be found in lumbago.*

"Some of the spinal ligaments have probably been injured if there is pain

⁸ INTERNATIONAL CLINICS, 23d Series, vol. iii, 210.

⁹ *The Practitioner*, 1914, xcii, 193.

when the patient attempts to bend forward or when the surgeon tries to extend the patient's spine. Forceful bending forward is the type of injury likely to tear the ligaments on the posterior aspect of the spinal column. The ligamenta subflava are also liable to injury in accidents that cause forcible bending forward of the spine, since they are composed of strong and dense yellow elastic tissue, holding the laminae together, and by reason of this elasticity they are concerned in the resumption of the erect posture after stooping. Thus a man who walks with his back bent almost double is unlikely to be the subject of such an injury, because that attitude is the one most calculated to put the ligamenta subflava on the stretch, and thus to increase the pain from which he suffers. The interspinous ligaments are stretched by movements of flexion, and relaxed by extension. The intertransverse ligaments are stretched by movements of lateral flexion away from the affected side.

"A large proportion of cases is not so simple, and often muscles, ligaments, and nerves are all involved. Here the patient is usually helpless, avoids the least movement, is totally unable to stand or turn over in bed, and the pain and tenderness are diffused. He may be afraid even to micturate or defecate. Such severe injuries may therefore be mistaken—as Herbert Page has pointed out—for cases of real paralysis. Time will settle the question, and as the effused blood is absorbed the greater part of the apparent paralysis will pass off, and the main injury, be it of muscle, ligament, nerve, or bone, will be thrown into stronger relief.

"The joints between the articular processes are injured fairly commonly, and are affected with ordinary synovitis. If synovitis exist, rotation and lateral flexion of the spine will chiefly be restricted.

"The intervertebral discs are sometimes torn, and give rise to one of the forms of incomplete fracture of the spine. The X-rays detect such injuries. Tuberculosis of the spine is said to follow this injury more commonly than any other spinal injury.

"Fracture-luxation rarely causes difficulty, since the picture is usually unmistakable, and immediate onset of paralysis below, plus the irregularity of the spine itself, is sufficient to disclose the nature of the case at a glance. It must not, however, be assumed that an old fracture is a recent one.

"Malingers nearly always assert that their pain or tenderness is in the midline over the spinous processes, and that it is practically limited to that situation. It is only in those rare cases when a fracture of a spinous process, or of some part of the vertebra near it, has occurred, or when direct violence has been applied to that situation by some small blunt instrument, that the pain and tenderness are likely to be limited strictly to the midline. If the patient complains of a fixed pain at a given spot, mark the exact position with a skin pencil, and make a careful note of its precise level and anatomical position. The alleged tender spines frequently vary in number and position every time one goes over them, not only at each examination, but at different times during each examination.

"As regards railway spine, most of the patients were neurasthenic before the accident, and the accident has only accentuated the neurasthenia. Many suffer from chronic sepsis, others from chronic intestinal stasis and auto-intoxication, and still others from gross or minor errors of refraction.

"In the treatment, limit the intake of purin foods and also of beer. If the

erector spinae is torn, put the patient to bed in the prone position, and place firm sandbags under the shoulders and pelvis to extend the spine and relax the injured muscle. Employ systematic exercises early, and, if there is muscular wasting or weakness, faradic stimulation. If an anterior ligament of the column be torn, the best posture is the arched spine, and with the back in flexion. Therefore, employ the prone position with sandbags and firm pillows under the abdomen. When one of the joints of the articular processes or a lateral flexor has been injured, the best position is the lateral with the injured side downward and a pillow under the loins, to procure flexion toward the injured side. In some cases the occurrence of an injury draws attention for the first time to stiffness in the back, due to some preexisting disease, as osteo-arthritis. Skiagrams may show osteophytic outgrowths in such cases. Employ early massage to relieve pain, promote rapid absorption of effused blood, improve the nutrition of the injured part, and thus limit muscular wasting; also, employ early passive motion and early systematic active exercises."

POSTANAL SINUS

CASE XII.—J. L., male, white, aged 40 years, single, printer, presented at the Surgical Out-Patient Department of the University Hospital (case-record 40223), April 4, 1914, complaining of "a discharging fistula at the end of the spine of several months' duration." Examination revealed a dimple in the mid-line near the upper end of the anal groove, which led into a sinus. This conveyed a probe upward and slightly forward for three inches, and the removal of the probe brought away several dark, long hairs. He was sent into the Surgical Ward to have the sinus dissected out.

This condition is due to failure of complete coalescence of the cutaneous structures in the sacrococcygeal region. The sinus is lined with skin, and there are often numerous glands and hairs in its wall. It may become infected. If its orifice becomes blocked, a form of dermoid results. The treatment is extirpation of the sinus if it causes annoyance. In diagnosis it must be distinguished from a sinus leading to a focus of osteomyelitis, and possibly from a fistula-in-ano.

LUXATION OF INTERNAL SEMILUNAR CARTILAGE OF KNEE; FISSURE FRACTURE OF INTERNAL CONDYLE OF RIGHT FEMUR

CASE XIII.—E. H., male, white, aged 26 years, single, driver, reported at the Surgical Out-Patient Department of the University Hospital (case-record 39800), February 10, 1914, with the history of having accidentally hyperextended the right knee six weeks previously. Thereafter he could scarcely walk upon the knee owing to the pain, which is worse at night. The knee locks in flexion at times. Examination revealed a joint-mouse slipping back and forth under the finger, just to the left of the ligamentum patellæ. There is crepitation about this body. There is also a serous synovitis. Skiagram (Fig. 14) revealed a small fissured fracture of the internal condyle. Operation revealed a dislocated internal

semilunar cartilage, which was ablated. There was also an hypertrophied villus, which corresponded to the joint-mouse. There was considerable synovitis before and for the first few days after operation; this had subsided before discharge. After leaving the hospital he still complained of pain going up and down stairs, and slight crepitation persisted, but both of these sequelæ disappeared with baking.

Luxation of a semilunar cartilage is an injury that is peculiar to the knee-joint. Its frequency renders it *the* characteristic injury of the knee, just as Pott's fracture is of the ankle, perforating acetabular fracture of the hip, carpal scaphoid fracture of the wrist, tennis elbow, and subacromial bursitis of the shoulder. In many cases the veil of mystery is never lifted to disclose these injuries, and they are treated as "sprains" or as contusions, and the patients are doomed to years of avoidable crippling, because of misdiagnosis or ill-directed treatment. A contusion means that nothing has been ruptured, nothing broken, nothing displaced. A "sprain" is only too often a term that is misused, just as is the term neuralgia or lumbago,—that is, as a convenient way of disposing of a case, or of fulfilling the obligation of having to give a name to a lesion that sounds plausible to the patient. To my mind, far from being the easiest, sprains and contusions are the hardest diagnoses to make, since they can be justly arrived at by processes of exclusion only,—that is, after every other likely lesion has been considered and rejected. Too often the pathology of knee-trauma is considered to embrace, if not a gross fracture, then a "sprain" or contusion, and the intermediate conditions are either unknown, or, if known, not looked for.

What are these intermediate conditions? Following the scheme pursued in dealing with injuries of the back, we find that, between the extremes of a fulminating lesion, such as a gross fracture, and a mere contusion, there may be: injury to the bones, as a fissured fracture of one of the condyles of the femur, as in my case, or of one of the tuberosities of the tibia, or separation of one of the tubercles of the tibial spine, or tear-fracture of the femur, tibia, or patella, or separation of the tubercle of the tibia (Schlatter's disease); bruising of the synovial membrane or of the articular cartilage, or tear, fracture, or luxation of the semilunar cartilages; luxation of the patella; and, finally, a "sprain," the pathology of which should be visualized either as an intrinsic rupture or else as an avulsion from its osseous attachment (including a few granules or a definite shell of cortex) of the following ligaments: the crucial, the alar, the capsular, the lateral,

or the ligamentum patellæ. In a paper entitled "Sprains and Strains of the Knee-joint," Cheattle¹⁰ outlines the subject as follows:

"As to the ligaments, lateral mobility indicates a general stretching or rupture, and is a serious sign. External rotation of tibia indicates rupture or stretching of the two lateral ligaments, because their joint action limits external rotation. The quadriceps tendon may be torn transversely above the patella, or the ligamentum may be ruptured. In either case there is inability to extend the leg. As to the cruciate ligaments, if it is possible to move the tibia forward, without being kept in contact with the articular surface of the femur, the anterior has been ruptured or stretched, or has torn away bone; if backward, the posterior; while if it is possible to rotate the tibia internally, both cruciate ligaments have been damaged.

"As to the cartilages, it is very difficult and almost impossible, unless by surmise, to diagnose separation of a semilunar cartilage, unless it can be felt. It cannot be told clinically whether it be split longitudinally or transversely, merely bruised, or partially detached. The anterior or posterior parts of the cartilage are sometimes detached. A detached piece of articular cartilage is generally a flat foreign body the size of a sixpence or shilling, and may be felt slipping about the joint cavity, most usually in the upper, inner, or outer parts of the suprapatellar pouch. A foreign body may be nipped or broken off hypertrophied fringe; a blood-clot; an osteophyte broken off; or a real body, as a needle.

"As to the bones, when the soft parts are thickened it is not wise to express a definite opinion, and every case of sprain or strain should be X-rayed. Bony crepitus is due to fracture of bone or to great destruction of the articular or semilunar cartilages, which has led to exposure of bony surfaces."

Discussing the mechanism of torn semilunar cartilages, Robinson¹¹ says:

"With the leg straight, a violent contraction of the quadriceps muscle may fracture the patella, but never tears the semilunar cartilage, because in full extension the capsule is taut, the cartilage is at the periphery of the joint, and the bones are 'screwed home' and locked, and then no rotation of the tibia on the femur is possible, though a slight rotation inward of the thigh on the leg takes place as the last stage of extension is being effected. With the leg flexed in part or bent to a right angle, a different condition of the parts obtains. Now the capsule is relaxed and rotation can take place; and when rotation of the femur inward or of the leg outward occurs, the capsule being loose, the anterior half of the cartilage is obliquely stretched across the articular surfaces immediately in front of those parts of the internal condyle and head of the tibia which are in close contact. Should now a sudden extension occur the cartilage is nipped between the two opposing articular surfaces and becomes a fixed point, and as extension of the limb rapidly proceeds the capsule is forcibly pulled outward by the contraction of the quadriceps, and, as the cartilage cannot follow, a rent in its substance occurs, generally either near its attachment to the capsule and antero-

¹⁰ *The Practitioner*, 1914, xcii, 351.

¹¹ *British Med. Jour.*, Jan. 17, 1914, 133.

posteriorly, or through its substance in the same direction or transversely, or one or more of its three anterior attachments is wrenched off or torn through.

"A certain diagnosis can often be made solely from the history. In nearly every case we learn by inquiry that there has been:

"1. A severe twist of the flexed knee or a severe blow on the side of the flexed knee, with or without the patient falling.

"2. A sickening pain, and often a sensation of something having given way in the joint. The pain is caused by overstretching of the unyielding ligaments of the joint by the bones being forced apart by the gripped cartilage when the extensors contract.

"3. 'Locking' of the joint,—that is, the inability to extend the limb (if the anterior part of the cartilage be torn) or, much less often, to flex it (if the rent is in the posterior half). The joint sooner or later goes straight of itself or by a special effort on the part of the patient, or is pulled straight by someone—generally with a feeling as if something had slipped into place.

"4. A temporary effusion into the joint (traumatic synovitis).

"5. One or several of the above symptoms, especially of 'locking' of the joint on a slighter but similar accident, such as slipping off a curbstone, twisting the leg in walking, or even turning over in bed.

"When the patient applies to the surgeon, often nothing can be made out on examination of the joint except some tenderness over the injured cartilage. If the femur has been rotated inward (or the leg outward), almost always the inner cartilage will be found torn; whereas if the rotation of the femur is outward (or of the leg inward), one cannot be so certain that it will be the outer meniscus that will be found ruptured."

Analysis of Robinson's 24 cases yields the following summary:

Internal cartilage	22
External cartilage	2
Right knee	14
Left knee	10

Ages.—18 to 48.

Sex.—Males, 24.

Occupations.—Coal-miners, 15; football accidents, 2. (The chief industries in this district are coal-mining and shipbuilding.)

Nature of Tear.—

(A) In internal cartilages (total 22):

1. In posterior half only	3
2. Torn anterior attachment only	2
3. Torn anterior attachment and from anterior part of capsule...	5
4. Bucket-handle tears,—that is, from the capsule only	6
(a) In whole length.....	3
(b) In middle half	2
(c) In anterior third.....	1
5. Longitudinal splits in substance of cartilage.....	2
6. Transverse tears in anterior half	4

(B) In external cartilage (total 2)—both had transverse splits.... 2

Robinson states that there can be no luxation of a cartilage without its being torn; yet there can be a tear without luxation. "Hence the name 'torn menisci' or 'torn semilunar cartilages of the knee-joint' should replace 'luxation of the semilunar cartilages,' just as the latter displaced Hey's original term 'internal derangement of the knee-joint' (1782)."

Murphy¹² states that the semilunar cartilages are more commonly fractured than luxated, and that they usually fracture on the edge and split into a fine web. "Many of the cases are a fraying out or loosening of the internal semilunar cartilage, and the symptoms are those of a continuous pinching of the small filaments of cartilage, often not so large as a No. 3 silk thread, each of which stretches across the surface of the joint and gives the patient an enormous amount of trouble—pain, lameness, and hydrops from the constant irritation, and, finally, a chronic fibrous synovitis.

"There are three varieties of floating joint cartilages. First, the accretion cartilage, which begins as a separation of a fold of the serous membrane or a small fragment; second, a fragment of cartilage of considerable size is torn loose in the joint and floats about but does not increase in size; third, an attached portion, either of the synovial membrane or of the fibrous tissue, becomes traumatized in the joint and increases in size, but remains attached, and, swinging around in the joint, it acts as a foreign body. These are different from the type of luxated or fractured semilunar cartilage, because a fractured semilunar cartilage (the more common) is always attached at the central or peripheral zone."

The treatment of luxation of a semilunar cartilage may be palliative or radical. Cheattle says that "if the separation of the cartilage is recent and has happened for the first time, try to replace it. If successful, immobilize for three weeks, then passively flex and extend, then immobilize for another week or two. Then treat as sprain or strain in which no locking has occurred. But if the separation has happened more than once, or a man's occupation might expose him to serious accident if there is no intervention, operate."

Murphy says:

"Some of the patients recover; at least, they go many years without having a recurrence. But in a large percentage, when once it occurs, whenever they put the limb in a certain position or in the same position as when the original luxation occurred, they have it again and again, and the palliative treatment is often

¹² *Surgical Clinics*, 1913, ii, 48.

kept up for two or three, or even four or five, years. Edmund Owen applied plaster casts and the patient was relieved, but the condition recurred again and again. The application of ambulatory apparatus is deceptive to the doctor and to the patient; they have no real value, and it is not the treatment for this lesion.

"It is the uniform practice now to advise removal of the cartilage, because if allowed to remain it keeps up a continual inflammation of the joint. The possibilities of danger are about equal to those of an interval operation for appendicitis. The hazard of infection is not so great as if we opened a perfectly normal joint, because here is a joint in a condition of chronic inflammation. In such a joint there is much less tendency to infection than where the conditions are normal and the tissues are not infiltrated and the lymph-spaces coffer-damned. In the early cases, unless there is considerable inflammatory reaction following the trauma to the cartilage, we aspirate and inject the joint with a two per cent. formalin in glycerine solution one week before operation. In older cases we do not do that at all.

"The incision begins three-fourths of an inch inside the inner margin of the patella, in a line with the patellar ligament, and extends down to the fibrous capsule. The latter tears but does not stretch, since it is inelastic. Avoid touching of the tissues with hands, sponges, or instruments: the service portion of the instrument is not allowed to come in contact with anything but the wound. Remove the cartilage. Close the fibrous capsule, being careful not to abrade the synovial membrane, lest adhesions form and a fibrous ankylosis result."

The treatment of ligamentous sprains is summarized by Cheattle:

"If an acute severe sprain, rest for 24 hours. If seen within the first five minutes, cold by Leiter's tubes or ice might arrest hemorrhage. After the first half hour apply large, hot, and frequent fomentations. At the end of 24 hours, gentle massage to thigh muscles and articulation, and passive movements may be begun. If a very severe sprain, continue this treatment three or four days and then let patient walk. At the end of a week massage of muscles and joint can be continued, and the patient should perform regular muscular exercises. *Do not keep too long at rest.* If a *chronic sprain*, employ regular specified exercises designed to strengthen the flexors and extensors, which have become very soft and atrophied. Keep this up for at least a year. *Use no splints or bandages.*"

Robert Jones, of Liverpool, an authority on joints, has this to say in reference to the treatment of ruptured ligaments of the knee-joint:

"The rupture of any of the ligaments of the knee should be treated by absolute rest until healing is complete. We know that four or five weeks are essential to their repair, and that any elongation or laxity allowed to remain means functional disability. We know, furthermore, that for the accurate repair of tendon or ligament no strain should be thrown upon them during the period of healing. *Nothing but temporary stiffness follows even prolonged rest.* We would have but few recurring displacements of the semilunars if the first injury were efficiently treated by resting the injured structures, more particularly the internal lateral ligament."

My apprehension of this is that from a consideration of the importance of the knee-joint in supporting the weight of the body, as well as of the fact that ligaments are composed of dense fibrous tissue with but slight vascularity, the conclusion must be drawn, that it is more logical to secure physiological rest by immobilization, at the same time maintaining the tonus of the flexor and extensor muscles by massage and electricity.

Another intermediate injury to the knee, and one that frequently escapes recognition, is that of rupture of the crucial ligaments, as well as fractures of the spine of the tibia. This ground has been well covered in a paper by Jones and Smith.¹³ Bearing in mind the attachments of the crucial ligaments, the important points to remember about their mechanism are:

“ 1. The anterior crucial ligament is tense when the knee is fully extended, and prevents the tibia from being displaced forwards on the femur.

“ 2. The posterior crucial ligament is tense in complete flexion, and prevents the tibia from being displaced backward on the femur.

“ 3. Both ligaments check inward rotation of the tibia.

“ Hence if, after an injury to the knee, the tibia can be displaced backward or forward or rotated inward in the extended position, an injury of one or both crucial ligaments may be diagnosed. To cause rupture of both crucial ligaments extreme violence is necessary—such violence, indeed, as would produce complete dislocation of the knee-joint.

“ As to treatment, in case of recent rupture of one or both crucials, fixation of the knee for a period of from three to six months offers the best chance of recovery, and immediate operation should not be resorted to. In neglected cases, where movement has been allowed early, fixation of the joint should first be tried. This fixation should be continuous. Where pain, disability, and recurring effusions occur, the choice lies between an operation for suturing the crucials, a mechanical support allowing flexion, or an arthrodesis. If the choice be in favor of suture, the capsule and ligaments should be made tense by reefing and stretching. It would be unreasonable to expect imperfectly repaired crucials to bear the great leverage to which they would be subjected in the presence of a lax capsule and lateral ligament.

“ As to fracture of the spine of the tibia, the most constant sign is an obstruction in full extension. The block feels like a definite bony obstruction, and is quite different from the locking which occurs when a dislocated semilunar cartilage is nipped. There may be

“ 1. Avulsion of the tibial spine or its internal tubercle.

“ 2. Fracture of the external tubercle of the spine.

“ 3. Injury to the spine, combined with fracture of a tuberosity of the tibia.

“ As to treatment, if met with at once, the knee should be manipulated until

¹³ *Brit. Jour. of Surg.*, 1913, i, 70.

full extension is secured. If there be no sign of laxity of the joint due to injury to the crucials or other ligaments, the fixation need not exceed two months. Good function may be confidently expected, in the absence of a bone block, to full extension. When full extension is not possible and disability exists in addition, whether it be pain, stiffness, or effusion, operation is to be recommended.

"To obtain a good view and simplify the operation, we would recommend that the knee be flexed over the table at almost a right angle, and that a vertical incision be made through the patella. An incision is made starting an inch above the patella and extending almost to the tubercle of the tibia. The patella is sawn vertically and its ligament split. The segments of the patella are separated to the border of the condyles. The fat behind the patella is removed, when an excellent view may be had of the spine and the anterior crucial ligament. Any obstructive mass is removed, and the knee is straightened. The ligament of the patella, the aponeurosis, and the quadriceps extensor are stitched. Arthrodesis of the knee, a perfectly justifiable procedure where the joint is very flail, is rarely called for."

Jones and Smith have seen 17 cases of injury to the spine of the tibia within three years.

Another injury to the knee that must be considered, particularly in children, is traumatic separation of the tubercle of the tibia, also known as "Rugby knee" and as "Schlatter's disease," it having been brought forward by Schlatter in 1903.¹⁴ Sir James Paget described the condition in his essay on periostitis following sprain. A case has been reported and the literature reviewed recently by Corben.¹⁵ It occurs usually between the ages of 13 and 16, and more commonly in boys than in girls. The cause is usually indirect violence, from sudden and violent action of the quadriceps extensor muscle.

"The symptoms are sudden pain in the front of the knee, temporary loss of power, and occasionally swelling and effusion into the joint, which may be so severe that the condition is mistaken for fractured patella. The symptoms may be so slight that medical advice is not sought for weeks or months, the condition being put down to sprain or growing pains. On examination, tenderness on pressure over the affected tubercle is practically constant. Not infrequently both knees are affected. As a rule the displacement of the tubercle is very slight. Crepitus is rarely felt. The diagnosis is decided by a skiagram taken laterally, in which the tubercle is seen separated from the tibia.

"The treatment consists of rest and strapping the knee; the requisite length of time varies from a month up to a year or longer. Complete cure can with confidence be promised, with, of course, enlarged tibial tubercle."

¹⁴ *Beitr. z. klin. Chir.*, 1903, xxxviii.

¹⁵ *The Practitioner*, 1914, xcii, 591.

And, finally, to show that it is not even safe to diagnose a contusion in the absence of a skiagram, the accompanying cut is presented (Fig. 15). This patient (case-record 40176) was struck by a motor upon the external surface of the left knee. After the accident he was able to walk without difficulty. No gross signs of fracture were evident, but there was a spot over the antero-external portion of the external tuberosity of the tibia, where "wincing" tenderness was so marked that a fracture was suspected. The skiagram revealed a vertical line of fracture passing through the external tuberosity. There was slight depression of the fragment, but it was supported by the head of the fibula and bound by the tendinous expansions.

FRACTURE OF INFERIOR EPIPHYSIS OF TIBIA

CASE XIV.—L. C., male, white, aged 10 years, schoolboy, was admitted to the Surgical Out-patient Department of the University Hospital (case-record 39618), January 21, 1914, with the history of having twisted his left foot in eversion. The ankle was swollen, and there was only moderate disability. Skiagram (Figs. 16 and 17) revealed a fracture of the lower epiphysis of the tibia.

This case is brought forward to show what is probably an alternative of Pott's fracture in childhood. It is one of several cases of epiphyseal fracture observed by the writer. Not much is written on this subject of fractures of epiphyses. While the upper epiphysis of the tibia is the more important as regards the growth of the shaft of the bone, yet the lower is important in that it models the tibial portion of the tibiofibular mortise, as well as the tibial malleolus. Were the fracture not properly reduced and treated, deformity of the ankle-joint might result. Almost of equal importance is it to recognize and treat para-epiphyseal strain, para-epiphyseal sprain, and epiphyseal disjunction.

A WORD IN BEHALF OF THE OPEN OPERATION FOR THE PROPER FIXATION AND REPAIR OF FRACTURES, WITH REPORT OF CASES *

BY FRANK MARTIN, M.D.

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I HAVE selected this subject of the "Open Operation for the Proper Fixation and Repair of Fractures" because I am more and more convinced that, if they can not be reduced by ordinary manipulative means, the vast majority of fractures should unquestionably be gone down upon and the fragments brought in accurate approximation without delay. The day has gone by when we are justified in allowing a patient with a fracture of the femur, or, for that matter, of any of the long bones, to be handicapped through life by a shortened member, due to overriding at the seat of fracture. During my student days it was usual to see a patient with a fractured femur recover with deformity and marked shortening; an inch of shortening was considered of no special moment, so the patient could bear weight on the member and hobble about as best he could. To-day the public is demanding better results. It is not willing to be handicapped by a short limb or deformed member following any form of fracture.

And just here, let me say, I think we owe a debt of gratitude to Dr. Lane for having put fractures on the map, as it were. His work really should be regarded as an epoch-making contribution to fractures; and his plate, known as the Lane plate, in my opinion is the best fixation device, certainly, that we have at our command to-day. I do not mean to say that it is absolutely satisfactory in every way, but that, as a method of fixation in the general run of fractures, it seems to me to be the best device we have. The ideal thing, of course, would be something in the way of a bone plate which could be in-

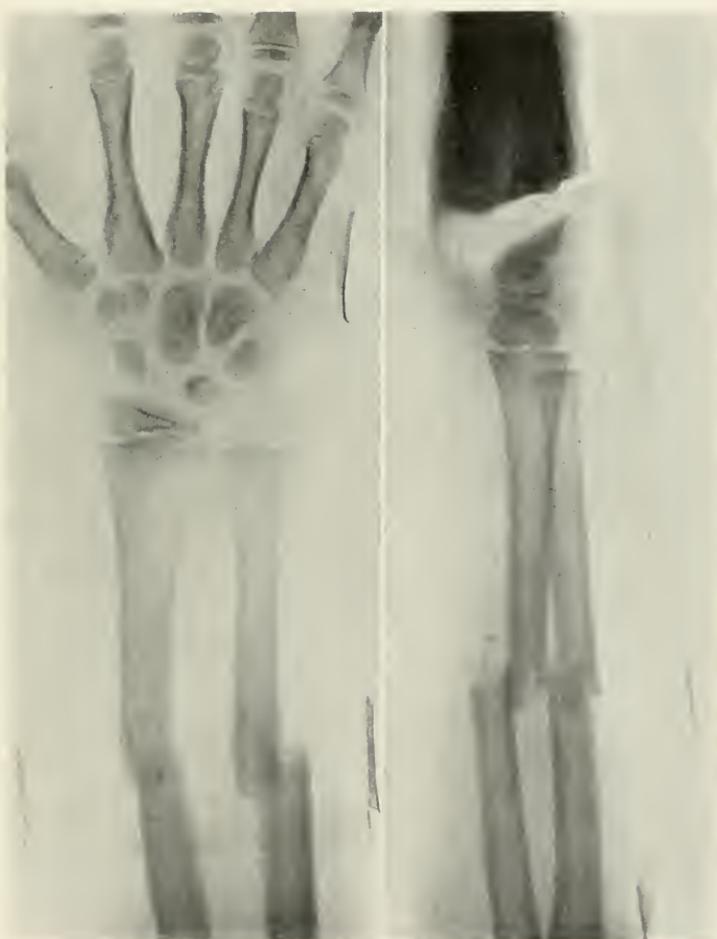
* Read before the Southern Surgical and Gynecological Association, Atlanta, Ga., December 17, 1913.

corporated with the callus and be converted into a living callus; but as yet such a device has not been worked out.

I, personally, have been for a long time going down upon and correcting fractures of the long bones, as well as those of the patella and of the olecranon, where I could not correct them by manipulation, extension, or what-not, by the use of other methods of fixation than are at present in vogue; namely, fixation by plates.

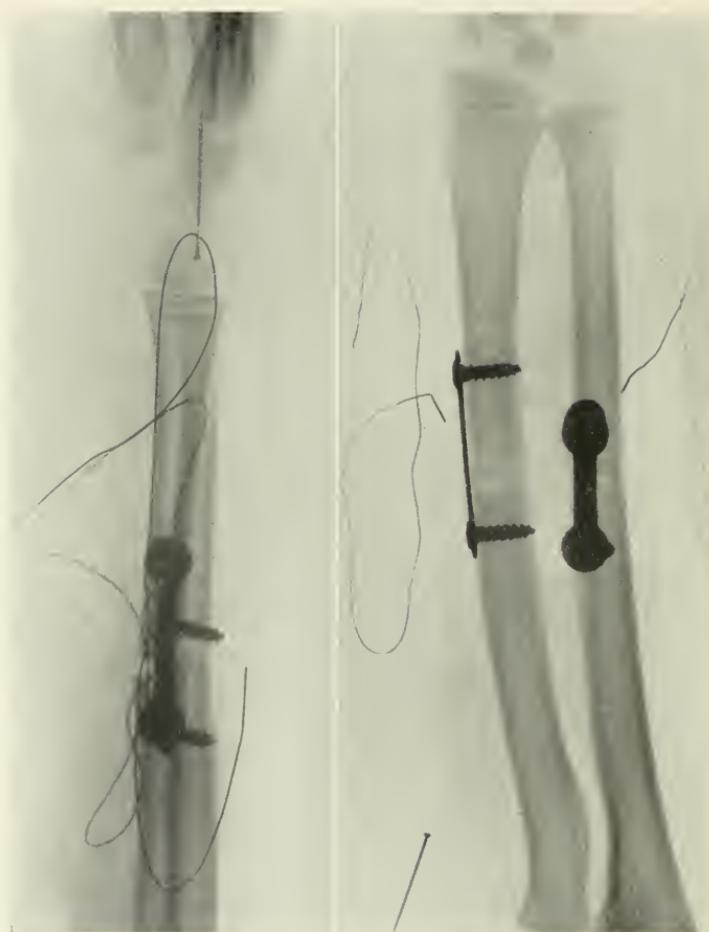
My views in the past have been that the least amount of foreign substance that could be used to bring about fixation was the method of choice; that is, if I could get the fragments in position and maintain them in position by the use of silver wire, I made use of that. I have many excellent recoveries among my records where this has been all that was necessary; but in some cases it was not sufficient as a method of fixation, and some slipping or displacement would occur at the seat of fracture, and then, too, I have not always been one of the eager advocates for the immediate open operation in all fractures. I have felt that a man should have sufficient training in the method of reduction of fractures so that he could adjust broken bones, bring them end to end, and maintain them in apposition by some splint which he knew best how to apply, and I believe to-day that, if a man is properly trained and taught how to reduce fractures and use splints, in many cases he could bring about, by a thorough knowledge of fractures, complete restoration without open operation; and I do not to-day believe that every fracture should be cut down upon; but I do believe that if after careful efforts have been made under complete anaesthesia and the correction of the fracture has not been perfect (which will be shown immediately following the efforts by an X-ray picture, the advances in which have made this work possible), then, if he has done the best he could and has failed to overcome the deformity, an open operation should be resorted to in all fractures of the long bones, whether they are near a joint or away from a joint, or at any point in shaft where there is a solution of continuity. The only exception I make in this is the fracture of the lower end of the radius; namely, Colles's fracture. Here I do not believe one is justified in going down upon it, and I do believe that a recent Colles's fracture should be overcome by reduction so completely as not ever to need open operation.

FIG. 1 (A).



Compound fracture of radius and ulna.—(A) shows anteroposterior and lateral view, with displacement and overriding in fracture of both bones of the forearm near middle.

FIG. 1 (B).



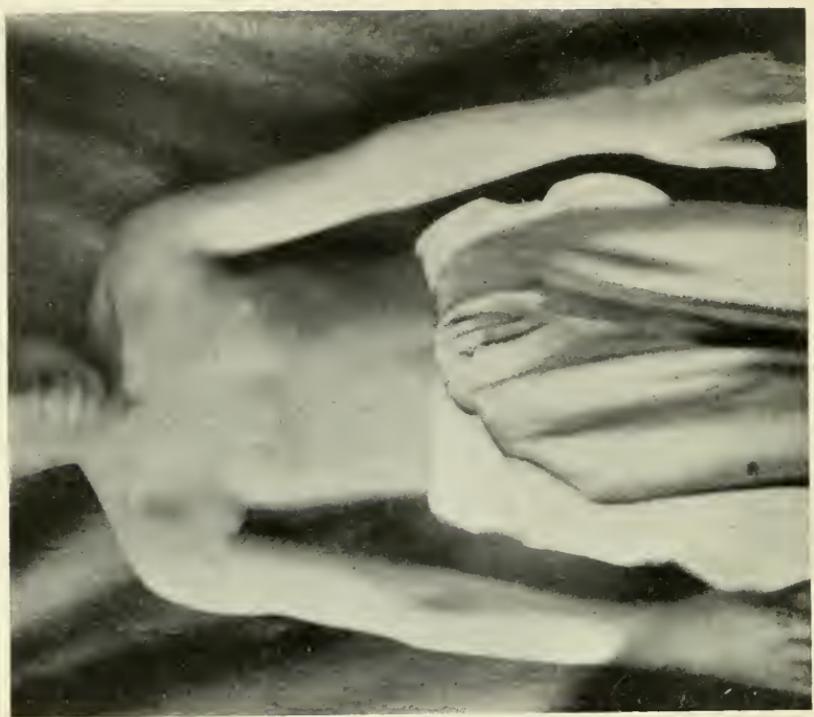
(B) shows lateral and anteroposterior views of the bones held in accurate position by plates; plates are seen in picture, and small lines on either side are the subcutaneous silver wire sutures.

FIG. 1 (C).



(C) Photo of the arm after dressings were removed, showing the perfect straightness and symmetry of the arm. He made an uninterrupted recovery and is still wearing plates.

FIG. 2 (B).



(B) Photo of boy's right arm, showing perfectly straight member without shortening and without deformity; excellent functional result.

FIG. 2 (A).



Comminuted fracture of humerus.—(A) shows plate and two wire bands put on to hold the comminuted fragments in position and make fixation at lines of fracture. This was successful in making complete fixation, so that the humerus could be moved about without difficulty.

FRACTURES OF BOTH BONES OF THE FOREARM

If fractures here can not be accurately corrected while under anæsthesia by careful efforts at reduction, they should always be gone down upon and plated.

FRACTURES OF THE HUMERUS

Most of the simple fractures of the shaft of the humerus can be corrected without the use of a plate, unless it is low down near the elbow or high up near the shoulder, or unless there is evidence of involvement of the musculospiral nerve, or unless it is a compound fracture: in these cases they should be opened down upon and plated, whether the joint is involved or not. I have several illustrative cases in with this list of cases, showing complete restoration of function in both elbow and shoulder, following fracture into these joints by resorting to open operation and plating the fragments. In one of my cases the elbow-joint was involved, and I opened down upon it and fastened the upper end of the humerus to the lower end, part of the plate extending to the joint, but it fixed the humerus and restored the joint so that he had a perfectly functioning elbow, which he could not have had, had I not gone down upon it. Likewise, in separation of the epiphyses with displacement, I believe they should be dealt with by open operation.

FRACTURES OF THE TIBIA

In fractures of the tibia I believe the open operation should be resorted to, and a method of fixation, either by wiring or plating, preferably plating—as it is much easier of application, much less difficult to get on, and produces firmer fixation—because there are many fractures which are so oblique and so definitely locked in deformity that they cannot be reduced unless you open down upon them, unlock them, and forcibly deliver bones into wound; even then they are oftentimes hard to reduce and get in apposition. Plating here is infinitely the method of choice.

FRACTURES OF THE FEMUR

These fractures, I believe, should be gone down upon and plated, universally, unless it is a transverse fracture and you are lucky enough to get them in position by ordinary methods of reduction;

this is perfectly possible in most fractures of the femur in small children. I fail to recall, in a long array of fractured femur cases in children, that I have had to go down upon them and correct them, and in the vast majority of cases have gotten perfect results by ordinary fixation with splints and extension. The modern surgeon is overlooking the tremendous value of traction in the treatment of fractures. This, of course, is alone of value in the conservative method of treatment of fracture of long bones. The X-ray pictures of end-to-end apposition are at times misleading, and, even if end-to-end apposition can be gotten by treatment in extension and side splints, the weight of the leg is very apt to bring about outward rotation of the leg which produces an altered gait, with some limp, even though there be no shortening and the limb be apparently perfectly straight.

As I have said above, the X-ray picture is confusing in that it will show an end-to-end apposition and show a straight skeleton at seat of fracture, but it will not show that there has been rotation of one fragment on the other, and the long axis of the shaft, being out of line, naturally throws the physiology of the muscles attached out of line, and, in consequence, faulty function is noted. This matter of external rotation outward of the lower fragment is of more importance than a moderate degree of shortening. By the open operation the normal axis of the long bone can be restored and the fragments fixed end to end, with the long axis of the shaft accurately corrected and the muscle power of the limb not incommoded, as it is in these cases that have been treated by extension, and, although straight limbs have been gotten, rotation has taken place. Furthermore, a thigh fracture plated gives a far shorter period of convalescence; the patient is able to be gotten up in a very much shorter period than the one who has been treated with the Gordon-Buck extension and long side splint, and the knee- and ankle-joints are not stiffened by long traction and immobilization, and are practically able at once to go on with their functions.

Fracture of the neck of the femur has always been a most doleful picture, always attended with shortening and in almost all cases with non-union, invalidizing the patient for life, if they recover. I believe, if the patient's condition warrants it, if the patient is not too old and there are no contra-indications, it should be gone down

FIG. 3 (A¹).



FIG. 3 (B¹).



Compound comminuted fracture of lower end of humerus into elbow-joint.—(A¹) shows the anteroposterior view: fracture is obliquely from outside down to internal condyle and into olecranon fossa, and sharp edge of upper fragment perforated skin, protruding some distance, with tremendous destruction of soft parts on inner side of elbow.

(B¹) shows the lateral view and does not show the deformity and extent of injury at all. This shows us very clearly the importance of taking the anteroposterior and lateral views.

FIG. 3 (A²).



(A²) shows anteroposterior view with the joint line clearly defined, and plate is seen holding the fragments well together.

FIG. 3 (B²).



(B²) shows lateral view with the plate immediately over the line of fracture and the fragments in good position. The screw in lower portion of the plate practically extended down into joint line. In this case I found it impossible to maintain any kind of apposition between these fragments without this method of fixation.

FIG. 3 (C).



(C) shows postoperative result taken nearly one year after operation; complete restoration of humerus; no interference with elbow whatever, has perfect motion, and humerus at lower end completely and thoroughly restored.

FIG. 3 (D).



(D) shows anteroposterior view, taken one year after operation; complete restoration of humerus; no interference with elbow whatever, has perfect motion, and humerus at lower end completely and thoroughly restored.

FIG. 3 (E).



(E) shows arm in perfect flexion with splendid functional result; beautifully developed biceps standing out, and no interference with the joint whatever.

FIG. 3 (F).



(F) shows the arm in extension.

FIG. 4.

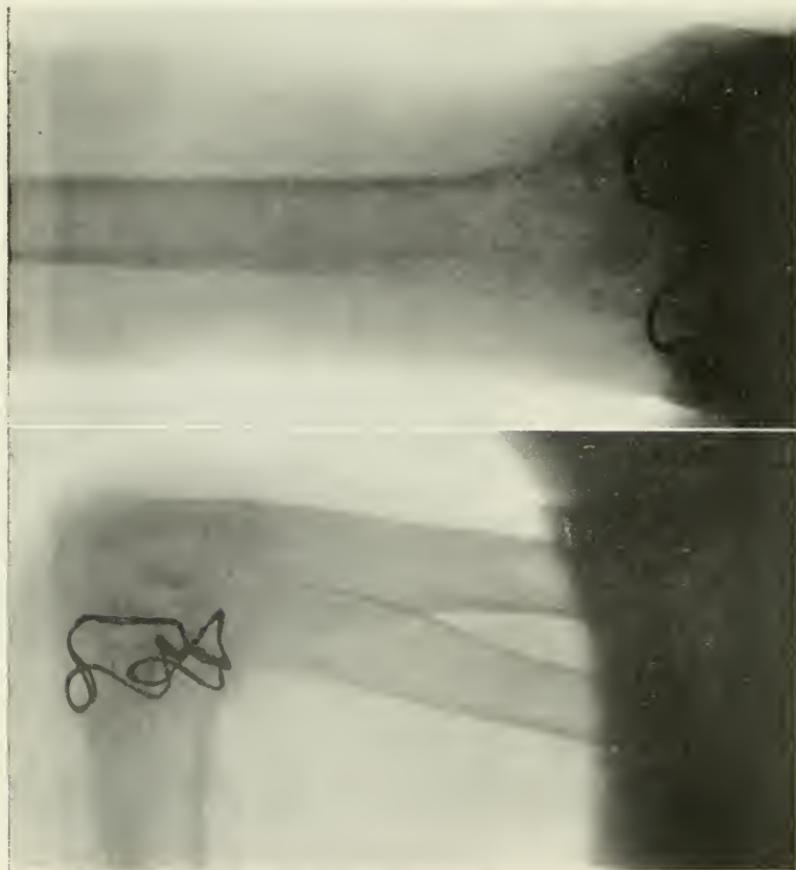


FIG. 5.



Compound fracture of lower end of humerus.—Picture shows the wires in place and the shaft of humerus brought in apposition with epiphysis. I did not have space in the lower fragment to apply a plate; in fact, it was done before I made use of plates. He had a good functional result.

Compound fracture of tibia and fibula.—Shows anteroposterior view with plate on and bones in perfect apposition. Had a perfectly straight limb and an uneventful recovery.

FIG. 6 (A).

FIG. 6 (B).

FIG. 6 (C).



Fractured tibia and fibula.—(A) shows displacement of fragments.

(B) and (C) show fragments end to end and plated.

FIG. 6 (D)



(D) shows photo of two limbs at expiration of five weeks with perfect symmetry, no shortening, no swelling; had good functional result.

FIG. 7.



Compound fracture of tibia and fibula.—Lateral view, showing tibia in good position with plate on.

FIG. 8.



Fracture of tibia and fibula.—Open operation done for fixation of this fracture; bad overriding, in which silver wire was used successfully in maintaining apposition; the picture shows the result at the present time, nine years after operation.

FIG. 9.



Fractured patella.—Picture shows two wires with fragments in good apposition. My custom is to put in two silver wires, approximating bony surfaces accurately together, rather than to use a plate. Excellent functional result.

upon and the fracture fixed in position either by plating or screws or nails driven through from the great trochanter into the neck of femur. I believe this is the proper procedure whether the line of fracture is intra- or extra-, or combined intra- and extracapsular.

I am convinced that if this plan of procedure is adopted,—namely, after earnest efforts are made to get the fracture reduced and there is failure to accomplish it,—then the open operation is the operation of choice, definite fixation being made at the seat of fracture. By the use of the Lane plate we can accurately fix end to end the broken fragments, whether comminuted or not, and give back to that long bone its perfect length and straight position, and one that will hold from the time the plates are put on, and the limb can be rotated as if it had been thoroughly repaired by callus. I have shown this on almost all of the thigh fractures I have plated. As soon as the plate is screwed tightly on the bone and there is complete fixation the bone can be moved about fearlessly. I believe, as Lane does, that a man has to have certain mechanical knowledge in order to accomplish these results properly. The man who is not handcraftsman or carpenter enough to mend the leg of a chair is not surgeon enough to mend a broken bone of the human body, certainly not by the open operation, and certainly he should not be allowed to do the open operation for the correction of a broken bit of skeleton anywhere. It is distinctly a major surgical operation, and should be undertaken only by those who are careful operators with good technic, and who are accomplished handcraftsmen. There is no surgical operation that requires more thorough and complete and careful knowledge of an aseptic technic.

COMPLICATIONS

If the operating surgeon observes the ordinary precautions, there should be no serious complications following. I have seen most shocking and brutal results, however, following the open operation method of treatment of fracture in the hands of inexperienced men. Only recently I saw a child lose not only its arm but its life: a little tot of four years of age who broke one bone of the forearm, a simple fracture, and the bone was cut down upon and wired. A rapid emphysematous gangrene occurred from filthy surgery, and I was asked to see it in consultation when this emphysematous gangrene

extended up to the shoulder. The arm was taken off near the shoulder, but the child died from the combined effects of that and the rapidly-spreading gangrene. It was totally unwarranted; a death due to meddlesome surgery; because in this particular case there was no reason in the world why this fracture should have been gone down upon, nor is it, in my judgment, ever warranted in the very young.

THE OPERATION

In ordinary simple fractures the seat of fracture is gone down upon, the periosteum is stripped back from the bones, the bones are delivered with Lane forceps—which I find the most excellent forceps for delivering bones and bringing them in position—the plate is applied, and the wound closed without drainage. I believe, as Lane believes, that careful covering of the skin, protecting the wound from any contact with things that have rubbed over the skin, is a very important step and should be observed; namely, sterile towels should be clamped around the skin edge after the skin wound has been made, and the skin immediately adjacent should be covered absolutely through the remaining steps of the operation. In compound fractures, where there is already infection at the time of operation, I believe plating should be resorted to, and, after callus formation has begun and there is evidence from sinuses or what-not that the plate is acting as a foreign body, it should be taken off. As a rule, a plate applied in compound fractures needs to be removed; for the chief object sought after is to get the bones end to end and hold them there while bone regeneration takes place, and this can only be done by some fixation device. Plates that are put on the tibia immediately under the skin, with but little covering, oftentimes have to be removed; usually I have found, in a long list of cases where I have, prior to my using plates, used wire, that the wire, when covered well, was buried and never acted as a foreign body or gave trouble, and in patella fractures, where I always use it, and use it to-day for bringing fragments in accurate approximation and maintaining them there, I have never had to take it away. I am convinced that this is the best means of fixing broken patellas; I have never resorted to any other fixation device. I have several illustrations contained in this picture list showing the wires in place.

FIG. 10 (A).



Comminuted fracture of femur.—(A) shows comminuted fracture of middle of left thigh, with marked displacement and small fragments separated from two larger fragments.

FIG. 10 (B).



(B) shows lateral view with fragments in apposition and plate on. In order to maintain the loose fragments in position a wire was put all around the circumference of thigh at that point, fastening it to plate.

FIG. 10 (C).



(C) shows the wound healed, and gives a lateral view of limbs.

FIG. 10 (D).



(D) shows anteroposterior view, taken seven weeks after operation, with patient erect; no shortening, no swelling. Had an excellent result and perfect symmetry.

FIG. 11 (A).



Comminuted fracture of femur.
—(A) shows comminuted fracture of upper end of left femur, with bad displacement.

FIG. 11 (B).



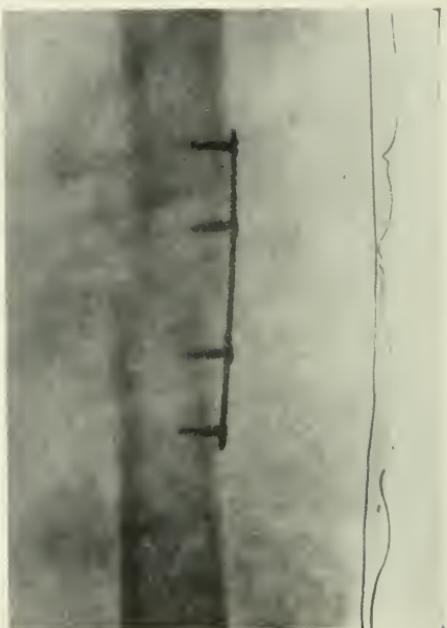
(B) shows the fragments in accurate apposition, but on account of comminution two plates had to be used: this brought the fragments accurately end to end and gave good solid fixation.

FIG. 12 (A).



Fractured thigh.—(A) shows fracture with marked overriding and angular deformity of ten or twelve weeks' duration; three efforts made to get fragments into apposition; certain amount of union had occurred in this faulty position.

FIG. 12 (B).



(B) After operation of separating fragments and bringing them end to end and plating them; plate is seen holding the fragments end to end. The fine line off to right of picture is the silver wire subcutaneous suture made use of for closing skin wound. He has complete restoration of length with perfectly straight limb, and has practically recovered from operation (being a recent case).

FIG. 13 (A).



FIG. 13 (B).



FIG. 13 (C).

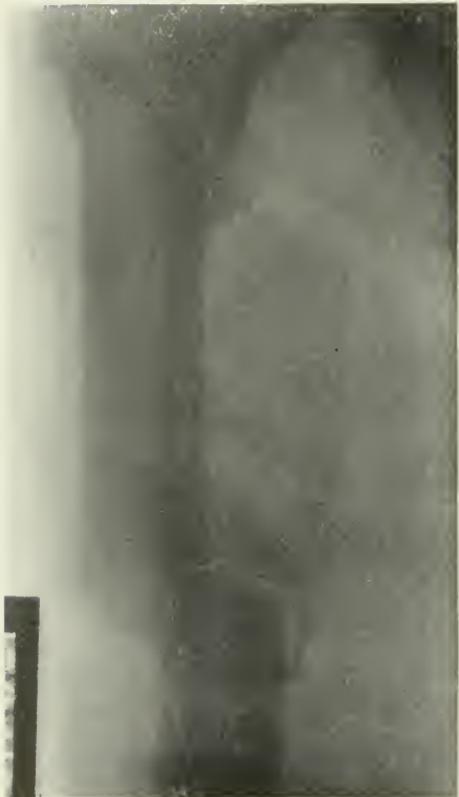


(A) shows fracture in upper third of thigh; line of fracture very oblique; lower fragment being pulled well upwards and inwards; upper fragment outwards.

(B) lateral view of limb following operation, showing cicatrix; as seen in the picture there is no deformity, no shortening, but perfect symmetry between two limbs.

(C) shows anteroposterior view with two limbs side by side without any evidence of any deformity whatever; limbs both the same length, with perfect symmetry and a good functional result.

FIG. 14 (A).



(A) shows fracture in middle of left thigh with marked overriding and deformity.

FIG. 14 (B).



Compound fracture of tibia and fibula.—
(B) Compound fracture of tibia and fibula with slight displacement.

FIG. 14 (C).



(C) Picture, taken eight months following adjustment of fractured tibia and fibula, shows bones united and callus at seat of fracture; the man was badly shocked when he came in, and I was able to adjust the bones satisfactorily, so did not go down upon them.

FIG. 14 (D).



(D) Picture taken 8 months after the thigh was operated upon and plated; plate is seen in picture, and a large amount of callus is noted at seat of fracture.

FIG. 14 (E).



(E) Photo 8 months following the injury, showing man with perfectly good leg, without shortening and without deformity; he was up and about on this limb two weeks after thigh was plated.

I think well of this same procedure, and always use this method in fractures of the olecranon, and prefer it to other methods of fixation. So, likewise, I have found, since I have been using the Lane plate, that when I can carry out my operation in a careful manner and cover the plate well I have not yet had to remove one. In superficial places, as over the crest of the tibia, I usually take it away, especially if it is a compound fracture, before the patient leaves the hospital, so that he will not be invalidized later by coming in to have a second operation done for its removal.

FRACTURED CLAVICLE

I believe the time may come when all broken collar-bones that cannot be held in position will be gone down upon and some method of fixation made use of; that is, if there is marked overriding that cannot be controlled. This need should be exceptionally rare, but an occasional case may have to be treated by this method. There is no excuse for bad overriding in fractured clavicle or ugly deformity, because the clavicle can be easily gone down upon and accurate approximation of fragments easily made, so that repair will go on and not be followed by ugly deformity which is so commonly the case in all fractures treated by splint application.

FRACTURED SHORT BONES

The only short bones that I have used the plating upon was in a recent case of fracture of the inferior maxilla where the fragments could not be gotten in position, where there were multiple fractures —one near the angle and one at the symphysis. I opened down and got the fracture in good position, and held it by a Lane plate with excellent results. It may be necessary to use smaller plates and screws than the ordinary bone plate.

Should we rely upon the fixation device alone, plating, wiring, or what-not, for maintaining accurate approximation while callus is being formed for repair of fractures?

This is a question I am not prepared to answer. Personally, I do not rely on the fixation alone, unaided by other external splints. I have not as yet had the courage to do that, but I presume that some men do. Lane, apparently, relies on the fixation device alone; whether it is a rule he adopts throughout I do not know, but with

the case of a thigh I saw him recently plate in Chicago he did not put on any external splints, only dressings to the wound. His ideas for not doing it were exceptionally good, and the principal one that he expressed was that he did not wish to immobilize the knee-joint, but wanted it to be free so that motion could be kept up and thereby prevent the stiffening from the long immobilization due to splints which handicapped the full usefulness of the limb for so long a time.

The bones seem so solid after the plate is on that one feels warranted in not applying an external splint, but I have as yet not adopted the plan. I have incorporated in this article a selection of illustrations that cover as near as possible the entire skeleton. Of course, the principal ones have to deal with the long bones, but there are some few short bones, namely, the phalanges and jaw, which are shown.

CONCLUSIONS

There are four chief indications for the open operation, and I incorporate them here as they emphasize most clearly the importance that we should attach to this method of procedure, and I think they are sufficiently clear to be in a measure conclusive.

(1) If after repeated attempts, if necessary, the bones cannot be placed in apposition or cannot be maintained in apposition, the open operation should be resorted to.

(2) If after reduction of fractures of long bones no crepitus can be elicited, you should be suspicious of interposed soft parts and resort to operation in order to prevent a delayed or non-union which produces an unnecessarily long period of convalescence.

(3) All open fractures, *as a rule*, should be cleaned, fixed, and, if necessary, drained.

(4) All cases of delayed or non-union and all cases of vicious union should be subjected to immediate operation; no efforts at reduction without operation should be employed.

FIG. 15 (A).



Oblique fracture of thigh - (A) shows oblique fracture of thigh in middle.

FIG. 15 (B).



(B) after patient was unanesthetized splints and extension applied; I considered the position sufficiently good not to go down upon it; excellent result, no shortening.

FIG. 16 (A).



FIG. 16 (B).



Subtrochanteric fracture.—(A) shows marked displacement of fragments, with upper fragment tilting well out; lower fragment strongly pulled upwards and inwards and found adherent to neck of femur. There was definite union in this faulty position, and at operation it had to be chiselled away; on account of this overriding there was at least two inches of shortening.

(B) shows the seat of fracture after the deformity was overcome and bones brought end to end; plate seen in the picture as applied at operation. Patient made good recovery; had good union, and plate is still intact, not having given any trouble. Good functional result.

FIG. 17 (A).



Subtrochanteric fracture.—(A) shows fracture through upper portion of the femur, practically running from greater to lesser trochanter; line of fracture extending generally into neck of femur, and it has the appearance of being a re-fracture at this point; almost a right-angle deformity here, with limb strongly adducted and utterly powerless to carry out any of its functions; marked shortening, possibly due to old fracture of shaft, which is seen in plate lower down. This occurred some years ago.

FIG. 17 (B).



(B) shows fragments in position and plated with two plates and limb put in strong abduction and flexed. After plates were adjusted the limb in its entirety could be rotated freely at the hip, showing that the hip-joint was not ankylosed, and full free rotation, flexion, and extension could be made after plates were put on.

FIG. 18.

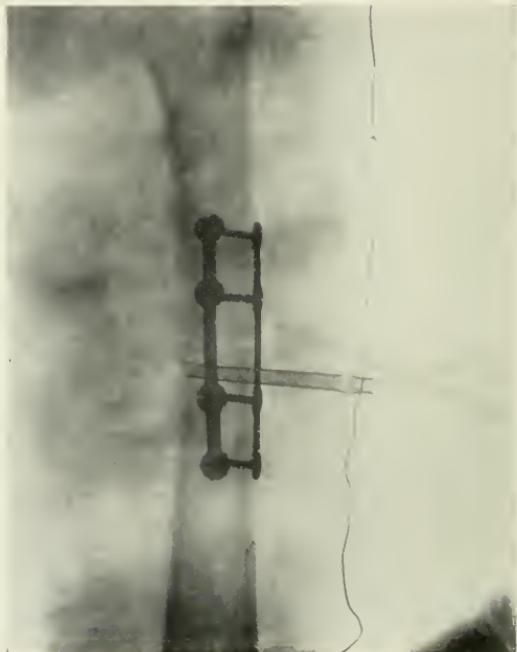


Multiple fractures of inferior maxilla.—He had multiple fractures of the inferior maxilla with marked deformity; one line of fracture was back near angle of jaw, where there was marked separation of fragments, and the other was in midline near symphysis. Picture shows two plates over seat of fracture back near body of jaw holding fragments in accurate apposition, and silver wire put around adjacent teeth fixing line of fracture in midline. After the plates were installed and wires put on the mouth could open and shut without difficulty and without motion at seat of fracture.

FIG. 19 (A).



FIG. 19 (B).



Fractured thigh.—(A) shows plate pulled off from lower fragment and angular deformity at seat of plating. This shows what may happen in these plate cases occasionally. Just why these screws pulled out and the deformity was produced, it is difficult to understand, except that the bone in this case was rather soft and the screws did not get a good hold in the shaft of the femur. There has been no effort at bone regeneration on the part of the patient in this case.

(B) shows two plates on and good bone apposition. In the picture at (a) is seen the drainage tube, which was put down to the seat of fixation. The long mark is a subcutaneous silver wire suture which was used to close the skin wound.

BLOOD TRANSFUSION BY VEIN-PUNCTURE METHOD

BY WILLIAM A. STEEL, M.D.

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THE mechanical problems of blood transfusion, or transferring whole blood from the vascular system of one individual to that of another, are to furnish a propelling force and to prevent the blood from clotting as it passes from one vessel into another.

The propelling forces successfully employed have been: First, normal arterial blood-pressure; the blood passing from artery of donor to vein of recipient. Second, the high venous pressure of an obstructed circulation produced by throwing an elastic band around the arm of the donor tightly enough to shut off the return superficial venous flow; the blood then being passed from distended vein of donor to relaxed vein of recipient. Third, a syringe may be employed draining the blood from the vein of donor and forcing it into the vein of recipient; the blood being immediately reinjected or defibrinated and then thrown into the vessel.

Clotting is prevented by bringing the intima of the vessels accurately in contact, or, if connecting tubes of some foreign material are used, by lining them with a fatty preparation, as paraffin or liquid vaseline.

In direct vessel anastomosis the radial artery of the donor is exposed for two inches; ligated at its distal end; its branches tied; a clamp applied two inches from the proximal end to control the blood current; the end cut squarely off; redundant adventitia cut away; the intima held by forceps; the adventitia stripped back from one-eighth to one-quarter of an inch. The most prominent vein at the bend of the elbow of the recipient is similarly prepared, and the two vessels are brought together by one of the following methods:

Carrell does an end-to-end anastomosis of the intima of the artery and vein, using fine vaselined silk in a manner similar to an end-to-end intestinal anastomosis.

Payr, Crile, Sweet, Elsberg, and Bernheim expedite the operation by tying one vessel over the other on specially-devised cannula.

Hartwell further simplifies the procedure by slipping the greased artery into the vein and holding it there by a circular external clamp.

The possibility of a reverse infection when the recipient is a septic case led Brewer to connect the two vessels by a bent glass tube coated with paraffin.

Bernheim improved Brewer's technic by connecting the vessels by a two-piece slip-joint cannula coated with liquid vaseline.

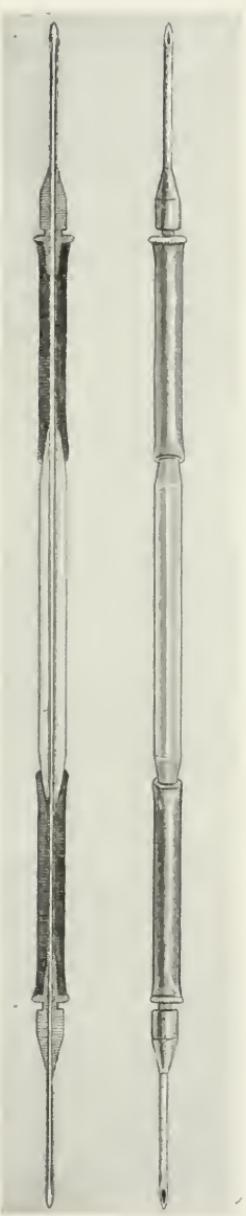
The above methods all involve the destruction of an important artery. Dorrance and Ginsburg overcame this by devising a vein-to-vein transfusion, anastomosing the vessels over a Sweet cannula.

Crotti and Lindemann have revived the old method of Bundell, sucking the blood from the vein of the donor into a syringe and injecting it into the vein of the recipient, Crotti dissecting out the veins and using a blunt needle to enter the ends of the vessels; while Lindemann simplifies previous methods by doing away with the open operation and vessel destruction. He forces special cannula directly through the skin into the veins of donor and recipient; drains the blood from one cannula into a syringe and reinjects it into the other cannula. The syringe technic is the only one where the amount of transfused blood is accurately measured. But the filling and emptying of the instrument makes one dread the possibility of clots forming in the barrel and about the connecting joints, and of their being forced as emboli into the circulation of the recipient.

The ideal blood-transfusion apparatus is one fitted for emergency work; that is, which does not require long laboratory training or hospital operating-room facilities for its use; which does not destroy the involved blood-vessels; where there is no open tissue contact between donor and recipient; which obviates the danger of miliary blood-clots, and where the quantity of transferred blood can be at least approximately gauged.

For years we have practised bloodletting through a large-calibre steel needle thrust through the skin and into one of the prominent veins at the bend of the elbow. The high blood-pressure developed in the veins where the return blood flow is obstructed by an elastic arm ligature and the ease with which any quantity of blood is withdrawn without clotting suggested the feasibility of allowing the blood to flow into the veins of another subject instead of into space.

Figs. 1 and 2.



Combination glass rubber and metal transfusion tube for connecting the vein of donor and recipient. The cross section shows its uniform internal calibre, with connecting joints so levelled that there are no sharp edges to encourage blood-clotting. The slip-joint tips of bleeding needles permits momentary disconnection to inspect the blood flow during the operation. The rubber connecting tubes give a latitude of motion not present in all-glass tube.

FIG. 3.



Instrument connected. — Needle introduced against the blood current into the distended vein of donor. — The high artificial venous pressure forces the blood through the oil-lined apparatus into the relaxed vein of the recipient, in the direction of the venous flow.

The apparatus devised for the purpose consists of a central piece of glass tubing, with rubber tubing slipped over each end, the rubber slipped over two steel connecting pieces and these fitted accurately into the butts of two bloodletting needles (Fig. 1). All parts are of the same calibre throughout—12-gauge—and the connecting joints so bevelled that there are no sharp edges to encourage blood-clotting (Fig. 2).

In using the instrument the parts are separated, then sterilized, and each lubricated inside with sterile heavy Russian mineral oil—best done by a bit of cotton on a nasal applicator. The arm of the donor is laid alongside that of the recipient. Elastic bands are placed above the elbows tightly enough to compress but not to obliterate the radial pulse; the skin antisepticized by rubbing with alcohol over the most prominent vein at the bend of the elbow; the puncture sites anaesthetized by a drop of cocaine thrown under the skin; the needle introduced in the direction of the blood current in the arm of the recipient and the elastic band removed; the second needle introduced against the blood current in the arm of the donor and the elastic band left on the arm; the apparatus quickly connected with the blood flowing from either needle (Fig. 3). When enough blood has passed over, the needles are withdrawn, and if oozing occurs the arms are bound up for an hour.

The rate of blood flow through the apparatus was estimated by bleeding a series of twelve cases. The pressure in the compressed veins was found to force out the blood at a uniform rate of eight ounces to five minutes. This was taken as the estimated rate of flow in our transfusion work.

The difficulty in the technic is in introducing the needles into the veins and in keeping them there. But the impetus given to intravenous medication since the introduction of salvarsan has trained a small army of transfusionists capable of carrying out such work.

The apparently weak point in the technic is the accurate estimate of the amount of blood flowing through the instrument. The relatively small number of cases which were bled seemed to show that the high artificial venous pressure produced by the superficial vein tourniquet is practically uniform in the healthy adult arm. This uniform pressure, combined with the fact that the calibre of the

blood-transferring tube is always the same, accounts for the accuracy of the rate of flow.

The indications for blood transfusion and its possibilities for harm as well as good should be thoroughly appreciated before attempting the operation.

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Obstetrics

THE OBSTETRIC FORCEPS: WHEN AND HOW TO APPLY THEM *

BY HARRY J. PHILLIPS, A.B., M.D.

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THE indications for intervention with obstetrical forceps during delivery may be conveniently grouped under the following headings: (1) Faults in the maternal forces; (2) faults in the maternal passage; (3) faults in the child; (4) dangers threatening life of the mother; and (5) dangers threatening life of the child.

It has been the custom of many authors to divide the indications between the two latter groups, and, of course, in a measure these embrace the others; but the more extended classification mentioned permits one to more fully explain when forceps should be employed.

FAULTS IN THE MATERNAL FORCES

The application of forceps should never be considered before supervention of the second stage of labor; but when the second stage has been reached, I can see nothing to be gained by allowing labor to continue indefinitely, even although both mother and child may be doing well. It has been my practice to terminate labor by the application of forceps after the second stage has persisted four or five hours, although both the maternal and fetal pulse-rate might be normal. The operation is comparatively simple, since, excepting in rare instances, the fetal head will have already reached the outlet; indeed, if it has not advanced thus far, the obstetrician should suspect some abnormality, such as malformation of the head or pelvic deformity.

It has been claimed by certain obstetricians that simple delay is no reason for intervention; *i.e.*, that one cannot place a time limit upon the duration of the second stage of labor. In theory this reason-

* Read before the West End Medical Society, of Louisville, Kentucky, April 14, 1914.

ing may be sound enough, but in actual application it entails additional suffering to the mother; moreover, it is certainly advisable where it is possible to do so, to prevent unpleasant disturbances in connection with both mother and child. The early employment of forceps in the second stage of labor merely as a convenience to the physician is unjustifiable, since if the child be forcibly extracted from a position high in the pelvis the risk of lacerating the vagina and perineum is greatly increased; but the other extreme,—*i.e.*, waiting until mother and child present signs of danger, no matter how long may be the delay in the second stage,—is also unwise; and those who follow such a plan will be disappointed in the results.

The general opinion of English operators is expressed by Herman, who, while opposed to early intervention in uterine inertia, thinks it unwise to indefinitely delay the employment of forceps. I wish to emphasize the importance of being certain that uterine inertia is really responsible for the delay, as this is rarely the true cause if the head is arrested high in the pelvic cavity.

FAULTS IN THE MATERNAL PASSAGE

Cases in this group most seriously test the judgment of the obstetrician. The forceps are instruments of enormous power, by means of which one can overcome obstructions in the parturient canal; but there is a well-defined limit to the tractile force which should be exercised. The power which can be exerted with one's forearms is a fair measure of the force which may be safely utilized. For the operator to "place his feet against the bed and pull with all his strength" is unjustifiable obstetric practice. It means that he is operating unskillfully, or has chosen the wrong procedure. I cannot too strongly discourage the employment of extreme force, a plan which has been too generally followed in the past.

In so far as the vagina is concerned, obstruction is uncommon, excepting at its lower portion. Malformations, cicatrices, tumors, etc., are occasionally encountered. However, they are extremely rare, and if decided obstruction be produced thereby it is advisable not to undertake delivery by simple traction. Proper incision with removal of the obstructing tumor, or cesarean section, should be performed.

At the perineum slight difficulty sometimes occurs, especially in muscular women, in whom, as a rule, labor is not easy; moreover,

certain women appear to possess peculiarly rigid tissues,—*e.g.*, elderly primiparæ; yet I have occasionally encountered marked tissue rigidity in young women. When uterine contractions are strong and regular, rigidity of the perineal muscles may be overcome by the administration of opium, preferably morphine combined with atropine. Failing in this, anaesthesia (even surgical degree) may be induced, and, if the maternal forces are still unable to expel the head, forceps should be immediately applied.

The most troublesome cases of forceps delivery are where the bony pelvis is at fault, not only because considerable manual dexterity is required, but mature judgment is necessary in deciding when the pelvic deformity is too great for successful delivery to be accomplished by means of forceps.

FAULTS OF THE CHILD

Among the fetal abnormalities which may necessitate the application of forceps may be mentioned: large size of the head, malformations, occipito-posterior and facial presentations, and difficulty with the after-coming head in breech presentations.

DANGERS THREATENING LIFE OF THE MOTHER

In this group must be included eclampsia, dyspnoea from cardiac disease, advanced phthisis, and other conditions in which, after the os is fully dilated, rapid delivery is deemed necessary.

DANGERS THREATENING LIFE OF THE CHILD

Some children appear to be more affected by the process of delivery than others. One must from time to time auscultate the fetal heart if there is any delay in the second stage, and also in the first stage if the membranes have prematurely ruptured. The normal rate of the fetal heart-beat is about 130. A progressive decrease in the pulse-rate indicates danger, and, should it decline to 100 or lower, no time should be lost in effecting delivery. Irregularity is more serious than simple slowing. It must be remembered that during a uterine contraction the fetal pulse-rate becomes slower, but should return to normal immediately after the contraction subsides. When it does not do so the child is in danger, and should be extracted as soon as possible.

CONDITIONS WHICH MUST BE FULFILLED IF FORCEPS ARE TO BE USED

Before one proceeds to apply forceps, several conditions must be fulfilled. (1) The os must be fully dilated; (2) the membranes must be ruptured; (3) the presentation must be suitable; (4) there must not be too great disproportion between the head and the pelvis; and (5) the head must be engaged.

(1) *The Os Must be Fully Dilated.*—It is questionable whether the application of forceps is ever justifiable before the os is fully dilated. Even when it appears of the greatest importance to effect speedy delivery, it is generally better to incise the cervix, since lacerations produced by forcibly extracting the head through an undilated os are usually ragged and may be sufficiently extensive to cause great shock to the mother. The explanation of this is that the cervix, not being dilated, contracts whenever traction is made upon the child's head. There is no doubt that the early application of forceps is responsible for a large percentage of the cervical lacerations and the resulting evils; on the other hand, it is well known that extensive laceration may occur during spontaneous delivery.

In contracted pelvis dilatation oftentimes appears to be arrested owing to the bony canal preventing descent of the head, and it is difficult to determine when the os is fully dilated. In such cases, however, the cervix is soft and relaxed, imparting to the examining finger the impression that no resistance will be offered to passage of the head.

(2) *The Membranes Must be Ruptured.*—I do not believe any great disaster would follow the application of forceps over the unruptured membranes, as it seems hardly possible traction upon the membranes could cause separation of the placenta. As a general proposition, however, the membranes should be ruptured before forceps are applied.

(3) *The Presentation Must be Suitable.*—The forceps may be applied in all vertex and face presentations, but not in brow presentations. The forceps may also be very useful in delivering the after-coming head.

(4) *There Must not be too Great Disproportion between the Fetal Head and the Pelvis.*—That is to say, the fetal head must not

be too large, as in hydrocephalus; nor the parturient canal too narrow, as in the presence of decided bony deformity. To decide this a careful bimanual examination of the head and pelvis should be made.

(5) *The Head Must be Engaged.*—Application of the forceps is absolutely unjustifiable in contracted pelvis if the head is still movable. Occasionally, however, the instrument may be employed with the head movable at the brim when immediate delivery is urgent, but only when the pelvis is normal.

PREPARATION OF THE PATIENT AND METHOD OF APPLYING FORCEPS

Before the application of forceps, it is of the greatest importance that the patient be carefully prepared for the operation. Every precaution should be taken to prevent septic infection. The hands of the operator, the instruments, etc., must be surgically clean, and the parts of the patient thoroughly cleansed. The bladder should be emptied by the catheter. If this be done, many cases of retention or partial incontinence may be avoided. Emptying of the bowel contents is also necessary, because it is extremely disagreeable to the operator to have faeces escaping during delivery of the child; and, of more importance, actual danger to the patient is thus avoided during vaginal manipulation. It is also desirable to have the patient under the influence of an anaesthetic. However, the writer has often-times applied forceps without the administration of an anaesthetic where the head was low in the parturient canal.

It is largely a matter of custom which position is selected for the patient to assume. The dorsal decubitus is preferred in all countries excepting Great Britain, where the lateral position is invariably employed. In the simpler cases of forceps delivery there is not much choice between the two positions; but in the high application of forceps with the head at the brim, or when the pelvis is contracted or deformed, the dorsal posture is preferable: not that the operation is easier in that position, but because the blades can be applied more exactly. Moreover, in contracted pelvis it is often-times advantageous to "drop the legs"; i.e., to place the patient in the Walcher or "hanging leg" position. The weight of the hanging legs depresses the anterior portion of the pelvis, thus causing an in-

crease in the conjugata vera; but the conjugate at the outlet being diminished, after the head has passed the brim, the posture should be changed to the lithotomy position. There is another distinct advantage which the dorsal decubitus possesses in case of "high forceps." If the deeply-anæsthetized patient is placed upon her side, although the head may be well engaged, it "slips out" of the brim because the body of the child gravitates to the more dependent side. Therefore the operator has to apply the instrument to the movable head, which may be thus forced into a position other than that in which it was moulding and trying to pass.

This brings us to the consideration of an important question, *viz.*, the proper relationship of the blades of the forceps to the maternal pelvis and the fetal head. Should the blades be applied relatively to the pelvis or relatively to the fetal head? The blades of any of the varieties of forceps are so constructed that perfect position is secured when they grasp the head transversely, and are placed transversely in the pelvis. If the head of the child always occupied the pelvis (with its anteroposterior diameter in the anteroposterior diameter of the pelvis), this could be readily accomplished. But the anteroposterior diameter of the head does not always occupy the conjugate; indeed, only at the lower part of the cavity is this true. At the brim it is in the oblique or transverse diameter of the pelvis, consequently in such instances the blades cannot grasp the head transversely and remain transversely in the pelvis. If one applies forceps to a dried pelvis it becomes at once evident that each blade has a certain range of safe movement, the limits of which are the ilcopectineal eminence and the sacro-iliac synchondrosis on each side. With the head occupying the oblique diameter the transverse grasp is still possible by applying one blade over these two points; hence the old rule under such circumstances, "Apply the blades in the opposite diameter to that in which the head lies."

The older obstetricians advocated a deliberate grasping of the child's head, and the placing of the blades against the head. Quite recently, however, the method of application recommended by many writers is that of introducing the blades at the sides of the pelvis and trusting to the grasp being satisfactory.

I will now describe how the forceps should be applied, and shall first mention an uncomplicated case where the head is low in the pelvis. With the woman in the left lateral position I believe it best to use the right hand for holding and introducing the blades, and the left hand internally for guiding them. When the patient is placed on her back each blade is best guided into position by the corresponding hand; that is, for the right blade, the operator's left hand; and for the left blade, his right hand.

The left blade is introduced by passing it over the fingers of the right hand in the vagina; the blade must be kept closely applied to the side of the fetal head, and carefully guided between the head and the lip of the os uteri. The handle is then depressed and carried well backward, which has the effect of bringing the blade over the most suitable part of the child's head; it also takes the blade out of the operator's way, when it may be steadied by the assistant. The second blade may be introduced as was the first, or it may be passed into the hollow of the sacrum and then rotated into position opposite the first. Not infrequently I also introduce the first blade in this manner. Difficulty in locking the forceps hardly ever occurs if the head is low, but, if it should, gentle manipulation or reintroducing the blades will correct the matter. The fact that the blades of the forceps have a good grasp will be shown by their locking readily, and by there being little separation between the ends of the handles. In high application, with the head in the transverse or oblique diameter, separation of the handles always occurs; but with the head low it always means that the forceps are wrongly applied, or that the child's head is lying in a different position than was supposed. If the handles are widely separated, the instrument should be removed and the position and attitude of the head again carefully examined before reapplication is undertaken.

In delivery with forceps the minimum amount of force should be employed, and in the accomplishment of this one should always try to force the head in the direction it would naturally be driven. In a normal delivery the occiput is forced lower and lower, and slowly rounds the symphysis pubis. The occiput does not usually become arrested at the symphysis pubis, but when this happens premature extension of the head occurs with the result that a larger circum-

ference is brought across the vulvar orifice and rupture of the perineum usually occurs. Such a *contretemps* is likely to eventuate if traction with forceps be directed too soon in the forward direction. In most instances I do not remove the blades before escape of the head. Leaving the blades in position while the head is escaping enables the operator to control the too rapid extrusion of the head. The amount of space the blades occupy is insignificant, and the only objection to prolonging their application is that if the head be imperfectly grasped, or if it slips within the forceps, a diameter longer than the suboccipitofrontal is thrown across the vulvar orifice. The mistake should not be made of removing the blades too soon, thus allowing the head to slip backward. If delivery be completed without forceps, the head should never be forced outward with the hand unless the occiput is prevented from unduly impinging upon the symphysis.

The application of forceps may be cephalic or pelvic. In the former the head is seized transversely, the blades resting over the parietal eminences; in the latter the blades are applied in relation to the sides of the pelvis without regard to the head.

In the high operation the application of forceps should be cephalic, and axis-traction forceps should be substituted for the classical instrument. If the ordinary forceps be used both hands are usually required for traction. To secure the most advantageous action the tactile force must be applied as nearly as possible in the axis of the birth canal. Axis-traction is possible, however, with the common forceps by Pajot's manœuvre, which is accomplished as follows: "The handles are held lightly with one hand near the lock, to avoid much compression, and the other hand is applied upon the shanks near the vulva. Pressing downward with the hand upon the shank, while the other pulls upward at the handles, the two forces may be so balanced that the resultant force shall act in the line of descent." A straight line passing through the umbilicus and tip of the coccyx is practically the line of traction until the head reaches the pelvic floor; this line is parallel with the symphysis pubis, which may be taken as a guide. In all high operations, and especially if there be pelvic deformity, where there is no reliable anatomical guide to the axis of the bony canal, the axis-traction forceps, which itself indicates the way and also permits the greatest possible freedom of head movements, offers a positive advantage.

OCCIPITO-POSTERIOR POSITION OF THE VERTEX

Rotation by means of the hand may be accomplished in about seventy per cent. of cases, and is a most desirable procedure, as it renders delivery of the head easier and safer for both mother and child. It sometimes happens, however, that rotation is impossible, or that the malposition is overlooked until forceps have been applied. Before engagement of the head the application of forceps is inadmissible. If the head is movable at the brim or can be pushed upward, I always endeavor to rotate, not alone the head, but the entire foetus, into the dorso-anterior position. If the membranes are intact, this is oftentimes possible by external manipulation. If the waters have escaped, one hand is introduced into the uterus to the posterior shoulder, which is gently forced outward away from the median line, the anterior shoulder being at the same time pushed inward toward the median line with the other hand externally upon the abdomen. This manœuvre is executed under complete anaesthesia. After bringing the occiput to the front, the head is crowded into the pelvic brim by external pressure, and forceps then applied if necessary. If the head is too firmly engaged to permit correction, the application of forceps should be withheld as long as possible. Generally speaking, rotation may be safely awaited so long as the pains are normal, the pelvic floor resilient, and both mother and child doing well. Instrumental delivery is more difficult and dangerous to both mother and child than when the occiput is anterior, and must not be lightly undertaken. No attempt at rotation should be made with forceps, except, perhaps, by an experienced obstetrician; otherwise injury will almost certainly result to both mother and child. I frequently remove the forceps when the head has reached the vulvar outlet, and then complete delivery by manual measures. After the head is well within the grasp of the vulvovaginal ring, I have in most instances been able to rotate the occiput to the front with the blade. By backward pressure against the anterior temple with the fingers of one hand, at the same time drawing the occiput forward, rotation may usually be accomplished without much trouble. Even should rotation be difficult, there is little risk of doing harm to either mother or child by properly-directed manual efforts. Rotation failing, delivery is completed with forceps. My experience has been that forcibly ex-

tracting the occiput through the outlet in primiparae is difficult and nearly always results in perineal injury.

FORCEPS IN FACE PRESENTATION

Forceps may be employed in face presentation with satisfactory results, provided the head has passed the pelvic brim and the chin is forward. When the chin is posterior, the application of forceps is contra-indicated. In impacted face position, symphysiotomy should be considered if the child be living and viable, otherwise the head should be perforated. In low mento-anterior face positions forceps delivery presents no especial difficulty. Careful attempts at manual rotation are permissible, but no twisting or rotating force with forceps should be employed. Extension must be maintained and the mechanism of natural delivery carefully followed. The only safe application is to the sides of the head, care being exercised to secure a firm grasp, reaching well backward to prevent slipping. Any other method of seizure not only endangers the child by pressure upon the neck, but is insecure. Traction is made horizontally until the child is well under the pubic arch; then, by raising the handles, the face, the vertex, and the occiput are successively carried safely over the perineum.

FORCEPS TO THE AFTER-COMING HEAD

In all breech presentations the forceps should be in readiness for instant use in the event difficulty is encountered in extracting the after-coming head. The application of forceps in head-last births, while seldom necessary, is the most effective way of delivering the head, and is attended with no difficulty. The body of the child should be held upward over the abdomen of the mother, and the blades passed beneath the fetal trunk.

IMPACTED BREECH

I have once accomplished delivery in impacted breech with forceps when unable to get my fingers in the groin. To secure the proper grasp upon the fetal pelvis the blades must be applied to the sides of the breech, with the tips placed between the thigh and abdomen of the child. This is oftentimes difficult of accomplishment, because the blades easily slip. When the breech has so far engaged that

a foot cannot be brought downward, yet has not descended sufficiently to permit use of the finger or fillet, forceps may be employed. In all applications to the breech it is difficult to so regulate the grasp as to be secure and at the same time prevent injurious pressure. The amount of tractile force should be maintained at the minimum by making traction only during pains, and by the aid of abdominal pressure applied by the assistant over the fundus.

In preparing the foregoing paper rather liberal abstracts have been utilized from the following standard text-books, and it is desired that full credit be extended to both authors and publishers for the privilege exercised in excerpting and reproducing the data:

JEWETT: "The Practice of Obstetrics," 1899.

KERR: "Operative Midwifery," 1908.

PETERSON: "The Practice of Obstetrics," 1907.

A UNIQUE EMBRYO, PRESENTING A PROBLEM IN EMBRYONIC NUTRITION

BY WINFIELD S. HALL

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IN the spring of 1911 the writer was the guest of a prominent medical man in central Illinois, and was out with the doctor on his afternoon rounds. In response to a hurry call he went into the suburbs of the city to find that a young wife, about six months married, had just aborted a three months' product of conception. The embryo lay undisturbed upon the bed sheet where it had been deposited. There was very little hemorrhage, but, to make sure that there was no retention of the placenta or any part of it, the patient was removed to the hospital and a curettement made during the evening; this brought away only shreds of what may have been placental tissue.

The woman made an uncomplicated recovery, but the embryo presented a remarkable anomaly: from the umbilicus a loop about 1 cm. in diameter protruded, and appeared to be the umbilical cord returning upon itself and entering the umbilicus. The embryo seemed to have had no umbilical connection with maternal tissues. The question naturally arose in the minds of all the medical men who saw the case, can the human embryo develop for a period of three months, apparently normal as to extent and course of development, but without umbilical connection with the maternal placenta? The problem excited so much interest on the part of these medical men that it was decided to subject the material to a critical study, and for that purpose it was turned over to the writer by Dr. Edson Hart, of Bloomington, Ill., whose courtesy in the matter is hereby acknowledged.

REVIEW OF LITERATURE

For a long time medical literature has been rich in citations and descriptions of foetuses with anomalous and pathological conditions of the umbilical cord. Most of the cases have to do with its variations in length, its coiling about the neck and other parts of the foetus, the

formation of false and true knots, the presence of cysts and tumors, variations in the disposition and number of umbilical vessels, and with peculiarities in the methods of its insertion.

In this discussion we are interested only in those types of anomalies which would likely be instrumental in radically disturbing the nourishment of the *fœtus in utero*.

In Vorstel's *Handbuch der path. Anat.*, Bd. 3, published in 1805, appears the following statement: "*Der Nabelschnur kann ganzlich fehlen.*" This statement, however, is of no scientific value, as it is based upon the hearsay evidence of midwives and obscure practitioners of the seventeenth and eighteenth centuries.

Hansen reported in 1839 a case in which a midwife, in whom he placed great confidence, declared that a seven months' *fœtus* was delivered which had no cord. The writer, however, was inclined to the opinion that a sac-like connection had existed between embryo and uterus through or along whose walls the umbilical vessels passed; but on account of the ragged detachment and collapse of this stubby connection, with profuse hemorrhage, its nature could not be accurately determined.

A somewhat similar case was reported by Madame Danthez, of the Bordeaux Maternity Hospital. Delivery at eight months was characterized by the preceding passage of a large quantity of amniotic fluid. The abdominal viscera were protruding from a rent in the region of the umbilicus, and no trace of the cord was to be found. The placenta was larger than normal, with a normal uterine face. Near the centre of the fetal face of the placenta was a vein about two lines in diameter, but no arteries were observed. On the concave surface of the liver of the *fœtus* a small vein was visible extending "three or four lines." To account for the nutrition of this fetus, the midwife suggested the probability of the absorption of amniotic fluid or the deglutition and digestion of the same.

The editor of the *Gazette* is of the opinion that the Danthez case is similar to that of Hansen, delivery being accomplished by the rupture of a sac-like communication with the placenta within the walls of which the umbilical vessels ran. Many abnormalities were observed in the *fœtus*.

Leopold describes an interesting case that is, however, remotely related to our subject. This *fœtus* was said to have been born at the

end of the sixth month, apparently having died at the end of the fourth month. The cord showed stenosis at the fetal end. It passed from the umbilicus backward between the thighs, and turned around the left thigh, being strongly adherent to it. It then passed to the right arm, encircling it also with adhesions. About 1 cm. from the point where it left the arm the cord was looped upon itself and had grown together. The placental end was normal. The amnion was bespattered with small blood-clots about the size of a millet seed.

An interesting case of torsion of the cord with resulting strangulation of the vessels is described by Chiaje. A seven months' dead fetus showed on delivery that the cord near the fetal end had been twisted about four times around, and was much stenosed thereby, showing on section umbilical vessels of greatly narrowed although open lumina.

Shaller described a fetal monstrosity weighing 850 grammes on delivery. There was no actual umbilical cord, for the abdomen was open, and the liver of the foetus and the placenta were separated only by the amnion. Vessels from the abdominal cavity entered the placenta directly, and thus to a certain extent fulfilled the physiological requirements.

DESCRIPTION OF THE FœTUS

The specimen came to the hands of the writer after having been preserved several weeks in alcohol and formalin. It measured 51 vertex breach, and the sex, although not positively to be recognized on external examination, proved on dissection to be female. Histologically the tissues were in a good state of preservation, although the epidermis and underlying tissues were partly exfoliated in places.

The only unusual thing noticed on superficial examination was a loop extending from the umbilicus and back again, which was thought by several who saw it to be the umbilical cord (Fig. 1).

Microscopic sections of the structure showed it to be a loop of intestine protruding from an opening in the anterior abdominal wall in the region of the umbilicus.

After the loop was removed the appearance was that of a foetus without an umbilical cord but having, so far as could be seen macroscopically, an oval-shaped opening with smooth edges from which a hernia of small intestine protruded (Fig. 2).

FIG. 2.



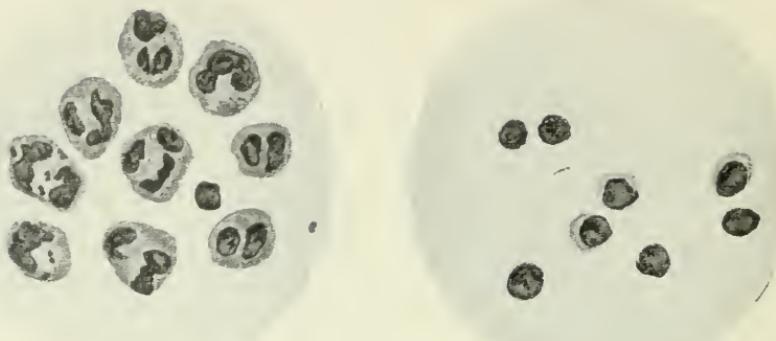
Same view after loop of bowel was cut off flush with body wall. Cut ends have receded.

FIG. 1.



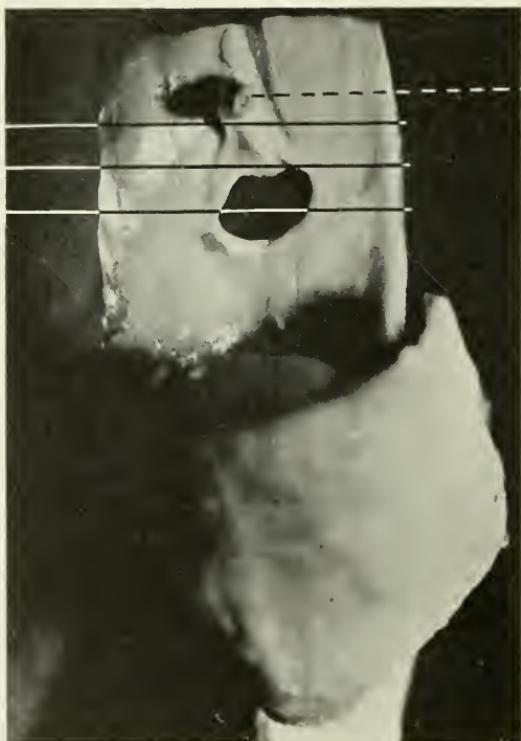
Embryo viewed from ventral aspect, showing loop of bowel protruding from umbilical region.

FIG. 3.



Section of blood-clot found in abdominal cavity, showing lymphocytes, nucleated reds, and fibrin. Magnified 600 diameters.

FIG. 4.



View of the anterior abdominal wall from behind, showing peritoneal surface. The peritoneum is unbroken across the midline below the umbilical opening. *Umb. v.*, intra-abdominal portion of umbilical vein as it leaves abdominal wall to enter the liver.

The body of the foetus was severed transversely about five millimetres above this umbilical opening.

The liver occupied most of the cross-section at this level. Within the peritoneal cavity, between the liver and ventral abdominal wall, was a stratum of material about two millimetres in thickness, having a gross appearance similar to the abdominal wall muscles of the same specimen. Some parts, however, had a more reddish tinge than others. The mass had been cut through by section of the body. After dissecting away the liver substance in the lower body section the stratum above mentioned was lifted out of the abdominal cavity with forceps. Two more or less pointed irregular processes extended down into the pelvis, while the thickest and largest portion was in the umbilical region. Stained sections of this mass showed it to be a blood-clot containing principally red cells, lymphocytes, and fibrin (Fig. 3). Special connective-tissue stains showed that organization of the clot was entirely absent.

The intestines were removed from the abdomen, and the ventral abdominal wall around the umbilicus was photographed from the inside. The stump of the intra-abdominal portion of the umbilical vein was left on the abdominal wall. This passed from the ventral wall and entered the liver some distance above the umbilicus. Below the umbilicus the ventral abdominal wall was uninjured, and the peritoneum was continuous across the mid-line, there being no sign of the urachus or hypogastric arteries (Figs. 4 and 5).

The portion of the abdominal wall shown in Fig. 4 was serially sectioned in paraffin. The sections show that the umbilical cord was torn off, leaving the ragged peritoneal edges around the periphery of the resulting oval-shaped opening in the ventral abdominal wall. They also revealed that the epidermis of the body continuous with the cord was torn apart in a similar manner, and, in fact, all tissues connected with the cord were thus lacerated. The intra-abdominal umbilical vein below the point where it left the body wall to enter the liver could also be traced into the open rent, although in this position the lumen was partly obliterated by collapse and contraction of the walls. [For sections at 7, 8, and 9 (Fig. 4), see Figs. 7, 8, and 9.]

An examination of the pelvic viscera showed that the upper

portion of the bladder had been torn off, leaving its exposed ragged edges visible in front of the uterus (Fig. 5).

It was necessary to remove the ovaries and fallopian tubes and pelvic peritoneum before the hypogastric arteries came to view. The left one had been torn off immediately distal to the point where the internal iliac branches were given off, and the right a little farther distalward at about its deepest location in the pelvis (Fig. 6).

The fact that at this stage of fetal life the hypogastric arteries are not imbedded in the ventral abdominal wall, but run freely, as does the urachus (intra-abdominal part of the allantois), through the abdominal cavity from the pelvis to the umbilicus, easily accounts for their rupturing in the pelvis, as in this case. The writer easily proved, to his own satisfaction, by pulling off the umbilical cords of fetal pigs, that the hypogastric arteries and allantois break off just as readily in the pelvis as at the junction of the cord with the body.

The summary of the findings is then as follows:

The umbilical cord of the foetus was torn off *in utero*, and a large part of the fetal blood was discharged into its abdominal cavity, where it formed a firm, tough clot with red cells and lymphocytes in the meshes of a rich fibrin network.

The umbilical vein was ruptured at the point of its entrance into the body of the foetus, and the hypogastric arteries and allantois in the pelvic region.

The deficiency in the abdominal wall had led to an umbilical hernia.

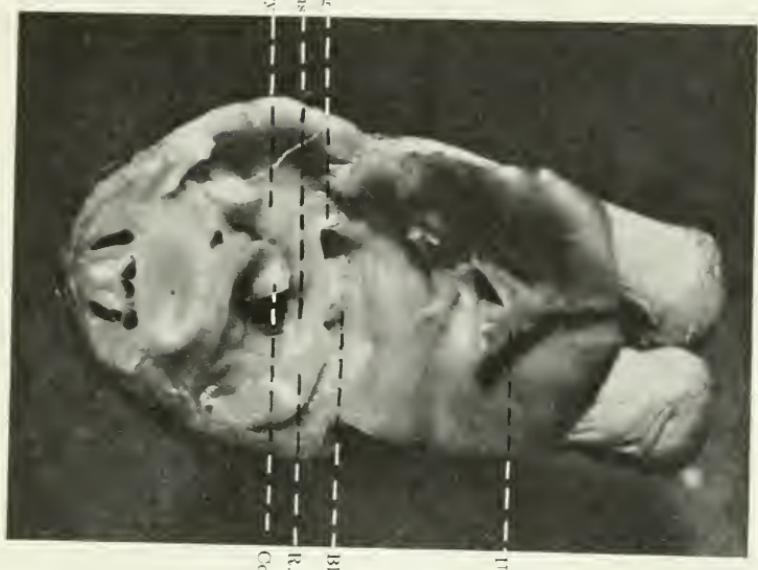
In spite of the scanty findings of the subsequent curetttement, the evidence is strongly in favor of the presence of a fairly normal chorion.

The fact that the blood-clot was still unorganized would seem to justify the conclusion that the embryo died soon after the rupture or severing of the cord.

There were no data on which to rest an estimate of the length of time which elapsed between the severing of the cord and the death of the embryo.

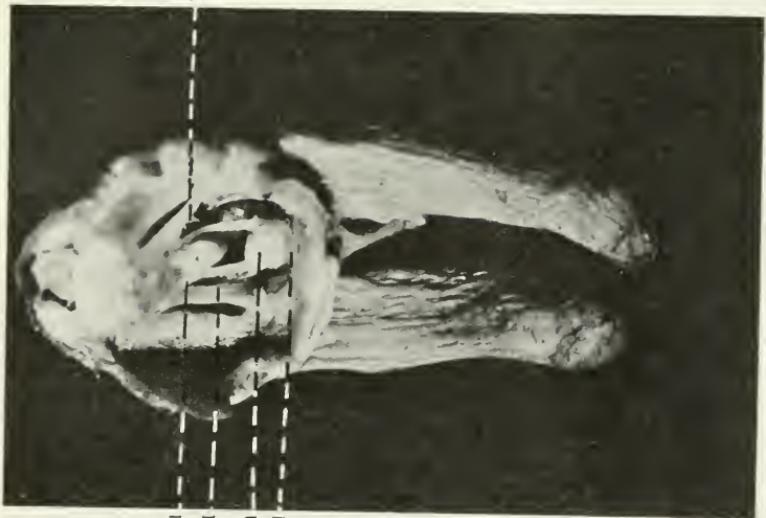
That an embryo might live a number of days after such an accident is likely. Experimental data from mammalian embryos would be valuable.

FIG. 5.



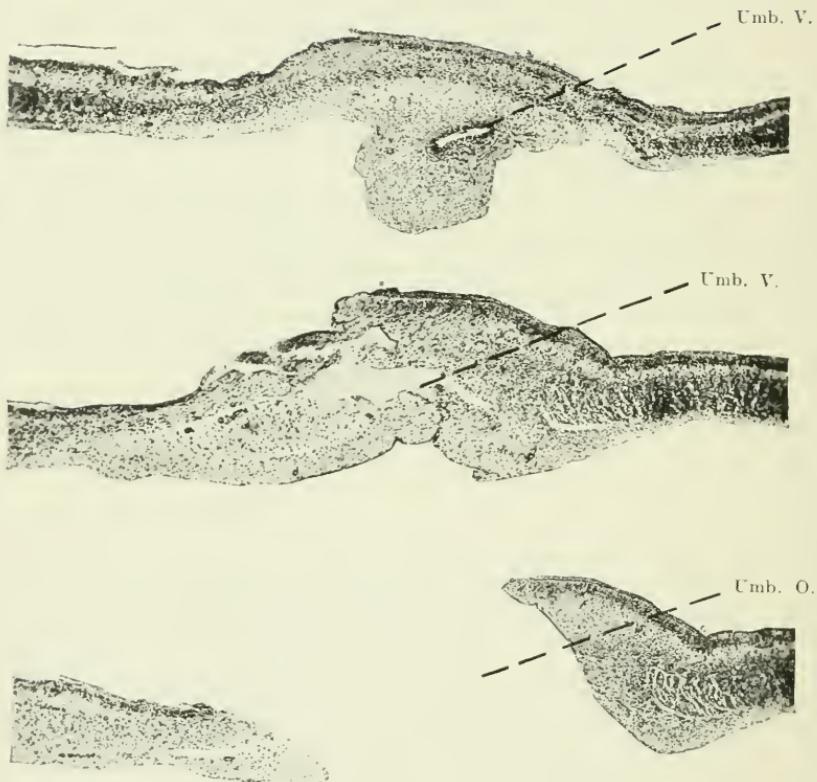
View of the pelvic viscera from above. The rugged, torn edges of the bladder show where the urachus separated from it.

FIG. 6.



View of the pelvic viscera with the peritoneum, ovaries, and Fallopian tubes removed. The rugged stumps of the right and left hypogastric arteries are visible. (Very plainly visible in a binocular dissecting microscope.)

FIGS. 7, 8, and 9.



Serial sections through the anterior abdominal wall taken as shown in Fig 4. Magnified 25 diameters.

FIG. 8 shows the cavity from which the walls of the umbilical vein were torn.
Umb. V., umbilical vein; *Umb. O.*, umbilical opening

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Child Welfare

THE TEACHING OF SEX HYGIENE

BY MARIA M. VINTON, A.M., M.D.,

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THE public mind has so far awakened to the knowledge of the many and sad results of venereal disease and the horrors of white slavery that a desire has arisen to save the next generation from the repetition of the errors of the present one. Good women and good men, in and outside the medical profession, have begun to clamor for the teaching of sex hygiene to the young. Yet they are groping blindly about, not knowing what they want taught or how best to teach it. They are appealing to us as physicians to tell them what to do. But the uncertainty extends to the medical profession as well. While they feel the necessity of preventing the physical and mental evils that result from the present bad social system, they are loth to lift the veil and disclose in its nakedness the whole of sex relations as they know them. On one side we hear the cry, "Let us teach sex hygiene in the schools." On the other we are told that such knowledge will brush the bloom from the cheek of the innocent girl. The girl seems to be the one who is getting all the attention at the present day, the boy being quite left in the shade. A school principal, who is herself a grandmother, said to me, "I don't want these nice little girls to be taught all these horrid things." She voices a quite general feeling that is based on a great misunderstanding of what is meant by teaching sex hygiene.

Certainly, avoidance of venereal disease and prostitution is not all of sex hygiene, nor even a small part of it. Very far should we be from wishing to teach all our nice little girls the "horrid things" of disease and prostitution. But have we taken time to realize how much these same little girls may read every day in the newspapers about white slavery, criminal operations, and life with a man who is

the husband of another? Witness the now famous case of a woman who lived three years a willing prisoner in the rear room of a married lawyer's office, which has been clothed in the newspapers with considerable pathos and romance.

Are they not learning from these same papers a great deal about sex relations? Again, have the objectors to the teaching of sex hygiene stopped to realize that these same pure little girls are gaining in the street and the companionships of the school life much knowledge of the subject, and in a most undesirable way? Many physicians have not yet realized that if we do not teach our children sex hygiene the street will do it for us, and is daily doing it for us. It is time for us physicians to be up and doing, to stop shirking the matter because we are loth to take it up. It is for us to formulate the method of teaching, and take an authoritative position in the community with reference to the presentation of sex plays in the theatres and scandals in the newspapers. Much that we are daily reading should never be seen by our children, and will do them far more harm than a modest and refined presentation of the story of life, and instruction in how to prepare for a healthy and happy wedded life that shall not end in disease or divorce. The very mystery with which we surround sex matters makes them subjects of interest and curiosity to the child. He will find out about them. The only question is, How and when shall we let him do it? When your father forbade your reading a doubtful novel, did you not straightway get it and read it just to see what he objected to?

As an example of what little girls in the best classes of society learn from companions, let me give you an illustration from life, absolutely authentic. A certain little girl, the child of one of the oldest American families, descended from Puritans and Pilgrims, living in the best of society, daughter of a well-educated, even learned father, and of a mother so refined that to this very day she is too modest to discuss sex relations with her daughter, was in the habit of playing with her brother and his friends. The children were taken by their parents to a farm belonging to a member of the family, where they spent their summers in healthful play and the supposedly pure companionships of the country. Her favorite playmate was a boy of her own age, of eight years, whom she implicitly believed she would marry when she grew up. These children were

allowed great freedom on the farm of twenty acres and in the neighborhood. They hunted birds' nests in the woods, gathered berries in the swamps, and enjoyed all the pleasures of the country. On a certain occasion this girl and her eight-year-old friend, accompanied by the ten-year-old brother, went to the woods, and the older boy placed the two younger children in the position for copulation and exhorted them to have sexual relations. Of course, the girl promptly broke away and ran home, sure they were doing wrong, but afraid to tell her mother about the occurrence, lest she be censured. It appears to me that it would have been far better for the child had she been able to tell her mother about it, and have been properly instructed in sex, rather than to have been obliged to lock it in her heart until she was a woman. In spite of Freudianism, she did not become hysterical nor develop any sort of psychic disorder as a result of the suppression of this memory. This was the time to have instructed her in the mysteries of life, and made her understand why she should not permit familiarities from the other sex. This is not an isolated instance, but can be duplicated any day from your own woman friends' experience.

So much for the child of the better classes. Let us now turn to the child of the so-called lower classes, and the foreigner within our gates. An illustration can be drawn from the happenings in a New York public school in a suburban district at the present day. In a certain ungraded class in that school is a little girl of eight years of age who was telling her mates, and afterward told her teacher, what she had seen in the hallway of the house where she lived. She gave a full description of how she had seen the sexual act taking place in the hall between two young people, one of whom lived there. What sort of innocence can we expect from an inhabitant of one of our continuous flats, with all the bedrooms opening into each other and into the living-rooms?

Another boy and girl from the same class have just been removed from their home because of the immoral surroundings. An older sister of eighteen has had intercourse with at least six different men; one of thirteen has slept with a man, and the younger girl of eight knows all about what is going on.

Dr. Evangeline Young, of the School of Eugenics, Boston, in an article published in the *Woman's Medical Journal*, cites numerous

cases in which little girls, from four years old up, had had their genitals handled by men and boys, and been taught intercourse before puberty, and had then been intimidated into keeping the matter secret. She gives case histories to prove her statements. Of 72 cases of girls examined by her against whom sexual crimes had been committed, in 48 this had happened before they were twelve years old. The youngest of them was but three years old, and contracted gonorrhœa in the act. Jane Addams cites numbers of cases in which girls had been victimized at an average age of eight years. These instances will serve to show the necessity of teaching what sex relations mean at a much earlier age than has been the custom. We blind our eyes and close our ears to what is going on around us, and then wonder at the sex crimes that go on about us.

We say, let us teach the parents sex hygiene, and let it be their duty to teach it to the children. They have the confidence of the children and are the natural instructors of youth. Let us ask ourselves, How many modern mothers have the necessary knowledge to teach their children the story of life? How many of those who know it aright have the courage to tell it to their sons and daughters? How many of the immigrants whom we are receiving by tens of thousands year by year have the knowledge to teach it aright? How many have the purity of mind that the teacher of such lore should have?

We say, let us not teach sex hygiene in the schools. But how else are these children to learn, if not in the school? We teach them to keep their bodies clean, what they should eat, how to cook it, and what to wear to be healthy. We even teach in the school how the blood circulates and the food digests. But never a word is taught them about the holiest, the most important function of their bodies. Every text-book on physiology used in the schools stops at the reproductive system. Every school book on biology ignores the process of reproduction except in the lower forms of life. We leave our children to grope about in the dark for knowledge of these important functions, to pick up a half knowledge wherever they may. Yet children daily talk to each other about these things, and hand on every scrap of information they may have gained. They are all agog to know where little babies come from, and we tell them that the doctor brought them in his bag that is too small to hold any

baby, or that grandmother found the baby under a head of cabbage in the garden. They laugh at our foolishness and go ask the older children. We insist that the child shall be able to take care of the money in his pocket and get the right change when he buys anything. He must know the products of the United States, its capitals and rivers, and the geography of foreign lands. But we let him get his sex instructions hit or miss, wherever he can pick it up, as he gets his candy and chewing-gum. When the child comes to us with a sensible question as to where he comes from, we say loftily, "It is not pretty to talk about such things," or "When you are older you will know all about such things." When he is older we have built up for him so high a wall of reserve about them that neither the child nor ourselves are able to get beyond it, and life's problem becomes a sealed book to many, until perchance marriage opens the eyes of the girl of a sudden. What wonder that she is often horrified by the knowledge that she gains in the honeymoon! Is it fair to the girl to let this be so? Is it fair to the boy to let him think that continence will do him harm, and that it is necessary to his physical health and manhood that he expose himself to the dangers of the house of prostitution? Yet this has been the practice of fathers and physicians up to within recent years. So much for the necessity of teaching sex hygiene.

Now for the method of the teaching. First, we must define our terms. What do we mean by sex hygiene? Hygiene means health. Sex hygiene means a knowledge of how to keep the sex organs in a healthy state. Can we learn how to keep them healthy when we know nothing about their structure or physiology? First of all, we must teach the child what his sex organs are, where they are placed, and how they act. But we need not do much of this work until he has nearly or quite reached puberty. Before this we must have laid a foundation on which to build sex knowledge, and this work we may begin as soon as the child asks his first questions about life. We may give him instruction in applied biology, beginning with the flowers and seeds, continuing with the lore of the birds, and later with the life history of his pets. We can show him how Nature reproduces everywhere through the intervention of two lives, which by the union of two cells or structures produces a new one. We can familiarize his mind with the words seed-germ and pollen-cell,

egg-cell and sperm-cell, baby seed, baby bird, mother and father bird, baby kitten, mother and father cat. He will draw his own inferences about where he comes from by analogy. Dr. Ira Wile says that as the mind of the child is pure and presents a clean page upon which we may write, these facts when written will not call up any obscene ideas as they may for us. To him they are only a part of the wonderful knowledge that he is daily getting of Nature's ways. When his mind is satisfied by knowledge purely given he no longer questions his fellows, his curiosity no longer leads him to seek outside the home the answers to these questions. By all means let the parents do this work if they are able. But let the school teach the child whose parent is so ignorant or so debased that he cannot teach it.

Shall the orphan and foundling go untaught because they have no parents? It is only the few that will be properly taught by parents. It is the many who are ignorantly falling into sin and disease for lack of right knowledge.

We cannot leave this knowledge for the Church to teach. It is the office of the Church to teach morality, and morality has much to do with these matters. But morality is not sex hygiene. Granted that in relation to sex we must have the uplift of morality everywhere, we cannot have applied morality until we have elementary knowledge of the sex organs and their action. It is the function of the parent to give the moral uplift when puberty and adolescence bring forward the need of self-control and care of these organs. But what of the child of the slum whose parents lack this moral uplift? Must they go without it?

As to the teacher of sex hygiene in the school: He or she must have, first of all, a knowledge of biology, botany, animal and human physiology more thorough than can be gained from the ordinary school text-book. This teacher must be a specialist in such knowledge, and must be specially trained for this work. The ordinary elementary school teacher is not prepared to teach sex hygiene. Who comes to-day nearest to being such a specialist as is needed? Is it not the physician, male and female, women for the girls and men for the boys? Then let us equip ourselves for this work and create a new specialty, which should be a well-paid one—the sex hygiene specialist. The earlier biological knowledge can be given

to boys and girls together. The later knowledge that comes at puberty must be given to the sexes separately. We must have for this work physicians who are used to dealing with children, who are able to talk simply on such subjects, who love the child and know how to draw out the best in him, and who are pure in mind and in heart to approach the holy of holies, the family.

As to the period of life when this instruction should be given: The biological foundation can begin to be built very early, as soon as Nature study is taken up. The author heard a married kindergartner talking to her five-year-olds about the trees and the baby birds, and how mother and father bird make a home. The writer said, "Why, you are teaching sex hygiene without knowing it." The answer was: "The kindergarten teaches everything." From such a beginning instruction in applied biology may go on through the curriculum until the child understands how life comes about in Nature. But not until puberty is near is it necessary to begin instruction in sex organs, self-control, and the moral aspects of sex except in cases of masturbation.

For those who find difficulty in teaching sex hygiene we give the following scheme. If the words "Sex hygiene" have acquired a meaning that they do not rightly possess, if there are objections on the part of the public to the subject under this name, let us call it "Applied biology," and let our special teacher be called the biology teacher. Her applied biology course may begin with the lowest grades. As we have seen, the child who has passed through the kindergarten class, in his Nature study has taken up sex hygiene without knowing it. Let this course expand with every year that he passes at school.

For a class of girls to whom the writer has been talking on this subject it has been called "The Story of Life," and this story has been divided into chapters. The first chapter has been "The Story of the Flowers and Seeds." After telling the child how the seeds grow to produce new plants, how we must plant them in fertile soil and give them plenty of fresh air, sunshine, and water to make them germinate, a single flower may be taken up. A picture is shown in which are represented petals, sepals, stamens, pistil, anthers, and pollen grains. Now unfold the story of how every flower has a pistil, a long column rising from the centre of the flower, having a

hollow tube running down into the cavity of the ovary, or seed pod. In this the seed-germs are arranged along columns, and these will become the source of the new plants. Next call attention to the stamens, with the anthers balanced like tiny powder boxes on the top of the slender filaments, ready to open when the pollen is ripe and scatter the yellow grains for the fertilization of other flowers. Tell the pretty story of how no flower is fertilized by its own pollen, but the grains must be carried about by bee and butterfly seeking honey, or wafted by the wind to other stalks. Tell how the pollen grains sink down through the tube into the pistil to reach the seed-germs, with which they become one, each pollen grain and seed-germ forming a new fertile seed that can produce a new plant. The pistil is the mother part of the flower, and the seed container is the ovary. The stamens constitute the father part of the flower, and carry the pollen or sperm-cells to the seed container. It needs both of these to make a perfect seed, so the pollen is carried about until it reaches the mother part of a plant, when seed-germ and sperm-cell become one. There is nothing obscene in this story, nothing that need offend the most fastidious mind. Let us remember that the pages on which we write this story in the young child are pure white pages, and no shadow of future evil need mar them.

The second chapter in the "Story of Life" is "The Story of the Birds." Every child loves to watch the birds which fly south as winter approaches to seek a climate where there are more warmth and more food. In spring they begin to think of housekeeping, and fly north again, seeking the place to build their homes. The same father and mother birds may choose each other for mates during several years, and rear several broods of birds. The young mother bird looks out for the handsomest, strongest father bird, the best protector and nest-builder. Here is an opportunity to teach heredity if we wish, and the necessity of seeking the strongest, healthiest, best bread-winner for a mate. So these birds contract to build a house together and raise a brood of young birds. They look for sticks and straws for the frame-work of the nest, and make a foundation in the crotch of a limb. Then they line the nest with soft ravellings and feathers for a bed for the eggs. When all is ready the eggs are laid. Just as in the flowers it took two organisms to make a fertile seed, so in the birds it takes two birds to make a fertile egg. Mother bird

carries in her body an ovary, as the flower did, a little bunch of tiny egg-germs. Father carries in his body sperm-cells like the pollen. When the right time comes father bird gives to mother bird the sperm-cells to put with her egg-cells, and the eggs are fertilized and grow into perfect little birds. Mother bird must warm her eggs by setting on them, covering them with her feathers, giving them the heat of her body for three weeks until perfect little birds have grown in the eggs. Many children have seen the domestic hen setting on her eggs, and have watched for the little hole in the egg shell which the mother widens until the baby chick comes out. The baby birds are far from being able to feed and live alone. They have big round eyes, large heads, little bodies, and long legs, and are nearly naked at first. Father and mother bird must work very hard to get enough food to keep them alive, make them grow, and form the little feathers which will make the wings strong enough for them to fly. For this they bring grains, worms, bugs, and many other things and place them in the little open mouths. This is just what happens in the human family. When the young birds are strong enough to live alone they fly out of the nest and go about, beginning again the same old story of the family. Many lessons of family affection and constancy may be drawn from this story. Here much moral teaching may be given if the child be not too young.

The lazy father bird who deserts his mate and leaves her to feed the young alone may be warned against: how unfair it is for him to leave the care of the brood to the mother alone. It may be taught how the marriage agreement should be so sacred that the father should never think of breaking it. Chivalry may be inculcated by the example of the protecting father bird and the selfish bird warned against, who is unwilling to do his share of the work.

The third chapter of the "Story of Life" is "The Story of the Kittens." In the spring mother cat, too, thinks of housekeeping. She and father cat have earned their living through the winter by catching mice and rats and ridding house and barn of these pests. They richly deserve the food and care that their master gives them. Now they begin to think of their new family. Mother cat carries in her body an ovary with its egg-germs, and father cat likewise carries the sperm-cells. When the time comes to raise a family father cat gives to mother cat the sperm-cells to put with her egg-

cells, and the tiny eggs are fertilized that will become the little kittens. Here the child learns the difference between the cat and the birds, between mammals and birds. While the bird warms her eggs with her feathers in the nest, the cat warms the kittens within her own body, in a tiny room that is prepared for them, near her heart. Following the story as told by Dr. Ira S. Wile, this is a room that grows continually until it can grow no longer. Then the door of the room opens and the living kittens are laid, just as the bird laid her eggs. Here we have come safely to mammalian life with the uterus in which the babies grow. You may explain as much or as little as you like about these structures. With the class that the writer has referred to she asked the girls what they thought the story meant. One very intelligent girl said, "It means the story of how we come into the world." "What did your mother say when you told her about it?" "She said it was a very nice way to tell about it."

If you are teaching boys, you may give them an idea of where the sperm-cells are carried. With girls this may be left out entirely.

The fourth chapter of the "Story of Life," "The Human Sex Relations," should be left for the arrival of puberty. Then maternity may be explained to girls, with its relation to menstruation. It will not now be difficult for the girl to understand the presence of the ovary with its graafian follicles, and the existence of the room that grows for the reception of the child. The boy will learn that his sperm-cells are not to be wasted or improperly used. The evil effects of masturbation may be explained and warned against. He may be taught that the manifestations of action in his genitals are normal; that they do not constitute a disease that must be treated. Thus he will avoid the lure of the charlatan and fakir. The girl may learn the sacredness of her charge; that she must be careful of her egg-cells, and keep them only for the one who shall be her life partner. Both may learn the sacredness of the marriage relation, the chivalry and care that are due to the woman, the fairness of the father doing his part to support the family, while the mother gives her time to bearing and rearing the family. Any child will have more love and respect for his mother when he knows what sacrifices she has made for him before his birth. We have early laid a foundation on which at puberty and in adolescence we may build the moral

structure which is to dominate life. If we have established perfect confidence with the children when they come with questions about life and its origin, we shall find it easy to answer these questions, and to explain the problems that meet the developing boy and girl. Without this biological foundation we have nothing on which to rest the superstructure.

In teaching a class of girls of about fourteen years of age the writer found herself at sea without this foundation; she was obliged to give this biological knowledge of life in a few words, a most unsatisfactory way of preparing the foundation. The superstructure she found partly built, and very badly built. First, she had to remove the old beliefs in order that the clean new ones might take their place.

To leave all this instruction until high school or college life, as has been advised by some, is like shutting the stable door after the horse has been stolen. A class of girls receiving such instruction just before their grammar graduation were shamefaced about asking the questions that they longed to have answered. "What do our mothers mean when they tell us we shall be ruined if we are not careful?" "Can a girl be ruined by another girl?" "What is a white slave?" They read about white slaves in the papers, but did not understand what they read. If our papers must print such things, and our children must read them, it behooves us to teach them how to interpret what they read, so that no glamour may lie about white slavery and prostitution.

As to when and how we should teach about venereal disease: We may teach hygienic truths as soon as we teach the child to wash his hands. We may teach him that he may take contagious diseases of any kind by the use of the common drinking-cup, the common towel, and indiscriminate kissing. But we do not need to teach the revolting aspects of venereal disease and prostitution at an early age. That should come only with adolescence and with the need of self-control. Venereal infection among children, although not rare, is almost always innocent. The author does not believe that we should seek to teach these truths through the stage. Sex hygiene, venereal cleanliness, sex morality are not for the stage. Sex plays create an interest in the subject that is abnormal and akin to curiosity alone. The stage is not the place for such subjects.

We are just now going through an epidemic of doubtful plays, the very criticism of which in the public press arouses a curiosity that brings out large audiences. It seems most revolting to think of young people attending these plays together. One would think they would blush to sit beside one another through some of the situations that are portrayed on the stage.

Sex novels the author would place in the same category. Woven in with the story of a great love the romance of the betrayed one is liable to excite sympathy and even pity, rather than horror at the sin represented. Works of fiction do not appear to be the best place to inculcate sex morality.

Finally, may we not hope that increased sex knowledge, and increased self-control taught the boy as well as the girl, and a single standard of morality preached from childhood up, may in the dim future produce a race to whom the sexual act may be a sacred one not to be used for self-gratification but to fulfil a duty? May not reproduction become a joy to both husband and wife? May we not hope that when woman understands better her obligations and opportunities she will less often demand the interruption of pregnancy for reasons of economy, or to save her figure?

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